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253 Broadway, New York.

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THE FIELD ELECTRIC RAILWAY PATENT.

The decision of Judge Townsend against the Field patent, which covered all forms of street railway traction, clears up the atmosphere in this field of litigation, though the effect of the decision had been largely discounted. The appearance of the General Electric Company as defendant in this suit, notwithstanding the former close connection of the Edison and Field interests, is explained by the facts that the Edison Electric Lighting Company withdrew its interest in the Field patent in 1889, and that it inherited the case just decided from the Sprague company. Judge Townsend, in his decision, held that an English patent issued to one Clark in 1864 anticipated every point in the Field patent, except the motor controller, and that the latter could not be considered as adding the character of an invention to the system claimed. In reply to a point made to the effect that the Clark patent named a magnetoelectric machine, while the Field patent included a modern motor, the court said that if that argument were to prevail, the inventor of the modern form of motor and not Field should be the beneficiary. The decision in this case marks the growing tendency of courts to discourage "blanket" patent claims, and the remarks on the patent of Clark have a bearing on the claims for the invention of the trolley device, now under litigation.

THAT $50,000 PRIZE.

In our last issue we referred to the passage of a bill at the closing session of the Legislature on the subject of a prize for the inventor of the most economical street railway traction system. As predicted, the bill, which has been signed by the Governor, is one authorizing the State Railroad Commissioners to act as umpire in the alleged competition of the Metropolitan Traction Company. The bill was signed on Wednesday of last week and on Thursday the president of the Metropolitan Traction Company gave the following statement to the press: "Last fall we sent a letter to Messrs. Alfred C. Chapin, Michael Richard and S. A. Beardsley, the State Railroad Commissioners, asking them to act as judges in a competition we proposed setting on foot. We offered a prize of $50,000 to any inventor who would offer an economical system of street railway traction which could be made available in this city, where the overhead system would not be permitted. The competition was to be open to all the world. We were flooded by letters from inventors. Between three and four thousand methods were sent us from all over. We could not wait for the Legislature to decide the question of the commissioners acting for us, however, and our offer had to be withdrawn." In other words, several thousand American inventors were put to an expense, which, in time and money, would amount to the value of the prize offered several times over by what, in the light of subsequent events, can only be denominated a sham competition. As remarked by us before, the time limit was so manifestly short that all who entered into the competition doubtless took it for granted that the company, which was presumably acting in good faith, would accord the necessary extension. The condition that the Railroad Commissioners should act as umpires was recognized by many as an impossible one in the absence of special legislation, but this was regarded, wrongly it now seems, as an oversight. The entire proceedings have an equivocal appearance, so much so, in fact, that it is probable that inventors who submitted plans will scrutinize with some interest the details of any system which the Traction company

may finally lay down. As to the Railroad Commissioners, it would be interesting to know in what light they regard the part which they have been made to play in the matter, particularly as their selection as umpires gave the appearance of good faith to the competition.

ELECTRIC CONDUIT STREET RAILWAYS.

The announcement of the Metropolitan Traction Company, that it has under serious consideration offers from two electric companies to lay down an underground conduit street railway and has accepted the proposition of one of them, is encouraging, though, with the knowledge obtained of the methods of this company through its recent sham inventors' competition, to which we refer elsewhere, its announcements are to be received with some caution. It has been officially stated, however, that two of the large electrical companies, one of which is the Siemens-Halske company, have made offers to put down an experimental road. The details of the latter system have been examined by engineers of the Traction company, and, on the strength of their favorable report, a trial of it will be made on Lenox avenue, where the company has recently obtained the right to lay tracks upon an understanding with property owners that an underground conduit system would be used. Three miles of road altogether will be laid at the expense of the Siemens-Halske company, and, if accepted, four miles more will be built at joint expense. The system proposed by the Siemens-Halske company is the one that has been in use in Budapest (described and illustrated in The Electrical World of Dec. 10 and Oct. 24, 1891, and May 14, 1892), the first line of which was laid down on July 30, 1889. This system is of the simplest construction, consisting of a conduit of pear-shaped section with two angle irons on one side, one for the in-going and the other for the return current. Sliding contact is made by means of shuttle-shaped sliders. Sixty cars are now run over the lines at Budapest at an everage speed of 12 miles per hour, and at a cost of 5 1-2 cents per car-mile, carrying in 1892, 14,000,000 passengers, an increase of 5,500,000 over the preceding year, and paying a dividend of 7 per cent. in 1892, with a considerable surplus carried over. It would thus seem that this system has demonstrated its practicability at Budapest, and it remains to be seen if the conditions at New York would militate against its success there. It may be noted that in a report of the United States Consul at Budapest, made about a year ago, it was stated that the operation of the road was several times interrupted by unusually heavy falls of snow, though otherwise its operation was declared successful. That the day of underground conduit roads has come cannot be doubted. It now only remains for actual practice to overcome the difficulties inherent in such systems, and we venture to predict that such practice will show that these difficulties are of much less moment than has generally been supposed.

INCANDESCENT LAMP LITIGATION.

Our budget of incandescent lamp cases this week, while extensive enough for the period when the litigation was at its zenith, probably marks the end of what in the future will be referred to as a series of causes celebres. A reversal of the present law, limiting the life of domestic by foreign patents, by the United States Supreme Court in its expected decision on the Bates refrigerator case, would prolong the life of the Edison patent to 1897, and thus cause a revival of the battle, but it is not thought there is any probability of this. As the law now stands the Edison lamp patent will expire in November of this year, and the intervening period is so short as to scarcely justify any important legal proceedings in the meantime. In the recent cases the honors are about equally divided. The General Electric Company was successful at Milwaukee, its opponent at Cleveland scored another victory, while in the Boston case no decision has yet been handed down. While the decision of Judge Jenkins in the Oconto case is not conclusive as to Goebel's alleged prior invention of the incandescent lamp, relating, as it does, only to the question of the existence of a reasonable doubt on testimony not subject to thorough sifting, yet its terms are little favorable to the claims advanced. That Goebel, in view of the struggle of the scientific world for decades to solve the very problem which he claimed to have solved as early as 1854, should, the court declares, "thus hide his light under a bushel, passes comprehension." The decision also lays stress upon the circumstance that Goebel was acquainted with the value of patent protection, and in small matters sought such protection; in the opinion of the court, it challenges belief that "he should have been so careful to secure his rights with respect to trifling matters and evince such utter disregard of his interests in a matter of great moment." The decision of Judge Ricks in the Buckeye case disposes of the plea on the part of the General Electric Company that the enormous blunder made when a wrong date was indorsed on the Edison patent should be held not to affect injuriously those who took no part in the act. The opinion, while accepting the plea of non-participation in the act of indorsement, holds that subsequent acquiescence disbars relief. This decision seems to definitely secure the status of the Buckeye company, as it does not appear possible for the complainant to secure any further hearing in court, no appeal being provided for by law. The case of the Boston Incandescent Lamp Company is interesting from the very considerable improvement in the manufacture of incandescent lamps which the claim at issue is declared to involve. A difference of over four cents in the cost of terminals is indeed an important one, representing, in fact, a saving of perhaps more than 20 per cent. in the cost of a lamp. The main point of law involved is also of interest, as it relates to the definition of an "equivalent," or the quality necessary for a substitute for one of the parts of a combination in order that the patent relating to the combination may not be infringed. This case is somewhat similar to the recent Novak case, but the point at issue is less ambiguous than was the question of relative vacuums in the latter.

Electrical Legislation at Albany.

But few laws of importance to the electrical world were passed by the Legislature that has just adjourned at Albany. A comprehensive review of the legislation pending was given in these columns on April 14, and the prediction then made that but few of the bills introduced would ever become laws has been amply verified.

Of the several schemes to incorporate big power companies, but one got through—the Niagara, Lockport and Ontario plan being the fortunate one. All the philanthropic schemes to reduce telephone rates, to cause trolley wires to be insulated, etc., went down in the general wreck.

Up to date the Governor's signature has been placed to the following new laws bearing on electrical matters:

Chapter 119.—Authorizing the Dunkirk and Fredonia Railroad Company to furnish light, heat, power and electricity.

Chapter 156.—Legalizing the incorporation of the Poughkeepsie City and Wappinger's Falls Electric Railway Company.

Chapter 207.—Extending for three years, from Nov. 1, 1894, the life of the Board of Electrical Control of New York City.

Chapter 260.—Authorizing the village of Springville, Erie County, to establish an electric lighting system.

Chapter 440.—Incorporating the St. Lawrence Electric Townsite Company.

The measures remaining in the Governor's hands are these: Incorporating the Niagara, Lockport & Ontario Power Company, repealing the law allowing electrical experiments on the canals, authorizing electric light and power companies to become railroad corporations empowering the water commissioners of incorporated villages to establish an electric lighting system after first submitting the proposition to the people.

American Institute of Electrical Engineers.

The eleventh annual meeting of the Institute will be held at the house of the Engineers' Club, 1,122 Girard street, Philadelphia, Tuesday, May 15. The preliminary programme, subject to slight changes, is given below in full.

At 10 A. M. Tuesday morning Mayor Stuart, of Philadelphia, will deliver an address of welcome to the Institute. At this meeting the yearly reports will be submitted, officers elected, and other business transacted, including action on a resolution favoring legalization of the units adopted at the Chicago Electrical Congress.

TUESDAY, MAY 15, 1894.

Opening Session.

The opening session of the general meeting for the reading and discussion of papers and reports will begin at 2 P. M.

1. "A Review of the Progress of the American Institute of Electrical Engineers."

An address by the president, Prof. Edwin J. Houston, of Philadelphia.

2. "On Light Distribution and the Use of Lamps," by Prof. Wm. A. Anthony, of Vineland, N. J.

3. "Discriminating Lightning Arresters and Recent Progress in Means for Protection Against Lightning," by Alexander Jay Wurtz, of Pittsburgh. Experimental demonstrations will be shown through the courtesy of the Philadelphia Traction Company.

A reception will be given in the evening by the engineers and manufacturers of Philadelphia, under the auspices of the Engineers' Club, and the Electrical Section of the Franklin Institute.

A theatre party for the ladies will also be organized in the evening.

WEDNESDAY, MAY 16, 1894.

Morning Session, 10 o'clock.

4. "Central Station Economy," by Mr. C. Reginald Van Trump, of Wilmington, Del.

5. "Unipolar Dynamos for Electric Light and Power," by Prof. Francis B. Crocker and Mr. C. Howard Parmly, New York City.

6. "Relative Advantages of Toothed and Smooth Core Armatures," by Mr. Alton D. Adams, of Worcester, Mass.

(Intermission.)

WEDNESDAY, MAY 16, 1894.

Afternoon Session, 2 o'clock.

7. "Test for Closed Coil Arc Dynamo," by Prof. R. B. Owens, of Lincoln, Neb.

8. "Alternating Currents and Fuse Wires," by Prof. Dugald C. Jackson and Mr. R. J. Ochsner, of Madison, Wis.

9. "Some Storage Battery Phenomena," by Mr. W. W. Griscom, of Haverford, Pa.

In the evening the annual dinner will be served in the Hotel Metropole, the price of which has been fixed at $2.50 per plate. This will be a purely social gathering. Friends may be invited.

THURSDAY, MAY 17, 1894.

Morning Session, 10 o'clock.

10. "The Waste of Zinc in Open Circuit Batteries When Standing Idle," by Henry A. Lardner, of Madison, Wis.

10. "Standardizing Electrical Measuring Instruments: (a) by the Potentiometer Method; (b) an Improved Direct Reading Potentiometer," by Mr. Elmer G. Willyoung, of Philadelphia.

Thursday afternoon will be devoted to an inspection of Cramp's Shipyard, followed by an excursion down the river to Gloucester, where a shad dinner will be served. While the members are visiting the shipyard Thursday afternoon, the Manufacturers' Club will entertain the ladies at the clubhouse, followed by a "tallyho excursion" to points of interest in and about the city.

FRIDAY, MAY 18, 1894.

Morning Session, 10 o'clock.

12. "Resonance Analysis of Alternating and Polyphase Currents," by Prof. M. I. Pupin, of New York City.

13. "Some Facts About Polyphase Motors," by Dr. Louis Bell, of Boston.

14. "The Law of Hysteresis (Part 3), and the Calculation of Ferric Inductances," by Mr. Charles Proteus Steinmetz, of Schenectady, N. Y.

15. "Experiments with Two-Phase Motors," by Dr. Louis Duncan, of Baltimore.

(Adjournment.)

The Electrical World takes pleasure in tendering the use of its branch office, 927 Chestnut street, to the members of the Institute and their friends who expect to attend the annual meeting. The office is within two minutes' walk of the Engineers' Club, where the papers are to be read, and within five minutes of the Franklin Institute and the Hanover Hotel. Members may have their mail addressed there and will be welcomed at all times.

The Cost of Producing Electricity.—II.

BY JAS. B. CAHOON.

Only a short time ago I had occasion to visit a lighting station and a railway power station in the same town; and as illustrative of the economical handling of coal and the method of keeping tally, these will serve as good examples, the one of the kind to look after things, the other of the hit or miss kind. In the central station the coal was taken in carts from the coal shed, run over a scale, carefully weighed, and then dumped directly in front of the furnace door, and a strict tally kept of every individual load. After the day's run the ashes were taken from the pits and floor in dump carts and also carefully weighed, so that in this way the manager could tell at any time the total amount of coal used, the amount on hand, and also the useful amount of coal consumed. At the other place they purchased their coal in 1,000-ton lots, and their method of keeping tally was by the guess of the fireman as to how many pounds he shovelled in; while as regards ashes, he never gave these the slightest attention. Therefore, when I asked for some figures in regard to the amount of coal used, in order that I might learn something in regard to the efficiency of a certain make of boiler which they used alternately with one of another make, they were unable to give me any data at all that were worth considering. I called the attention of the president of the road to this condition of affairs and suggested the advisability of keeping run of his coal, mentioning that it would be handy for him to know how much he had on hand at any time, so as to be in the market in ample season to replenish his supply. A short time afterward I saw him again, and he said: "I had a very good illustration of what you were saying about coal shortly after you left. According to the reports, we had on hand enough coal to last us for another month, but I discovered, on investigation, that we had hardly enough to last us ten days, the fireman having underestimated his coal consumption. We have now started in to weigh every pound of coal burned."

It is just the same with coal as it is with the testing of machines; if the data are worth keeping at all, they are worth keeping well and accurately; it does not involve any great amount of extra work, and ought to prove of very great value, especially to stations that are running pretty close to the wind and may find it necessary to institute comparisons between different kinds of coal to ascertain which kind is best suited to their boiler and class of attendants to give the most economical results. Having once ascertained this, they should be conservative about changing to another kind, the most uniform results being obtained by using the same kind of coal right along; for nothing will demoralize a fireman so much as changing the kind of coal continually; even the very best firemen in the world will kick at this, and if persisted in for any length of time will make them leave for a more rational place.

There is a point in regard to the economical use of coal entering as a factor directly into the cost of the production of electricity which seemingly has escaped the attention of many central station managers. If we refer to Messrs. Robert W. Hunt & Co.'s tables for the cost of evaporating 1,000 pounds of water, it will be seen that so far as the fuel is concerned the cost varies directly as the price of coal and inversely as the rate of evaporation per pound of coal, though the ratio therein expressed is an odd one. As, for instance, the table shows that it costs the same to evaporate 1,000 pounds of water with coal at $4 per ton, where the coal is capable of evaporating 10 pounds of water per pound of coal, as it does where the coal costs $2 per ton, and the rate of evaporation is 5 pounds of water per pound of coal. The question, then, as to which will be the more economical for the company to use will depend on the price of labor in

handling the coal, as it will be readily seen that with the cheaper coal it will be necessary to handle twice the amount in order to evaporate the same quantity of water as with the higher priced coal; therefore, this factor wants to be taken into account in determining which quality of coal shall be used. If we consider, now, the cost of the labor required in evaporating 1,000 pounds of water, these same tables show another point which is also apt to escape the attention of the station manager. We find roughly that the labor cost varies inversely with the size of boilers, and in an irregular way with the number of boilers, and also varies directly as the price of labor. The main point to which we wish to call attention is the fact that the minimum cost is obtained when each man has all the furnaces to tend that he can comfortably handle, and if another boiler be added, necessitating the services of another man, the costs immediately jump up, because we have gone beyond the limit of the power of the single man. When the other is added the combined work of both is about the minimum of value, because neither has enough to keep him wholly occupied, and nothing is so expensive as idleness where the cost of labor enters as a factor. I have found in quite a number of instances that station managers in reckoning up the cost of power have neglected to reckon in the amount it cost them to dispose of their ashes; this, in some cases, especially with the poor kinds of coal, amounts to quite an item, and in order to obtain correct results should not be neglected in any case.

Another factor which enters not a little into the cost of producing electricity is the arrangement of steam piping throughout the station, and the utilization of the exhaust steam or waste gases to heat the feed water. Many of our small stations throughout the country, who are running non-condensing, will find it a very great advantage to make use of their exhaust steam in this way, as every degree of heat gained in the temperature of the feed water means that it takes so much less coal to get the desired result. No matter by what diversified paths we go in seeking economy, we find they all eventually end in the coal pile, and all the various economizers and devices to produce economy of this or that are, in effect, an arrangement to save waste in the coal pile; and therefore the wise station manager will do everything that he can to save at this point.

So much has been said in regard to the gain that can be made by the introduction of condensers, that it seems trite to add anything further, but a very good example of this came to my notice a short time ago, and I give it, in the hope that it will lead other station managers who are now running non-condensing to investigate their surroundings, and if possible to change their stations over, so as to run their engines condensing. The station which I have in mind has a maximum output of about 1,500 h. p. divided into small units. The general manager of this station, who is one of the ablest in the field, and fortunately possesses a good knowledge of steam engineering, shortly after his appointment saw the advantages to be gained by running condensing, and after a careful investigation laid the matter before the board of directors, and kept at it until the change was authorized. In order to obtain the necessary supply of water it was found that they must either use city water or run a line of piping on their own account into the harbor some 1,200 feet distant, and draw their supply from that source. The latter plan was finally decided upon, and has been consummated with the result that it has effected an average actual saving of $25.71 per day in their coal consumption, which, at the price they pay for coal, is equivalent to 7 3-4 tons per day. To offset this saving lies the interest on the cost of the pumps and the laying of the piping, together with the cost of the horse power for driving the pumps; this last, of course, being quite small and hardly noticeable in a day's run. The whole of the items mentioned are not equal to half the amount mentioned above as being saved; thus, through the foresight of a competent manager, the company is enabled to add about $5,000 a year to its dividend. It is quite needless to remark that this pays.

The Field Electric Railway Suit.

Judge William K. Townsend, of the United States Circuit Court, at New Haven, Conn., on May 3, rendered an important decision on a final hearing of a bill in equity, alleging infringement on letters patent, granted to Stephen D. Field, July 16, 1889, for improvements on electric railways and assigned to the complainant, whose motion was finally denied.

The evidence of infringement, as stated in the decision, applies to the combination of a stationary dynamo-electric generator driven by a suitable motor and circuit of motors, composed in part of an insulated or detached section of the line of rails of the railway track and the electric magnetic motor mounted on a wheeled vehicle and used for propelling the same, and included in a circuit of conductors; also a current controlling device placed upon such vehicles. The defense was a denial of infringement, anticipation by prior patents, publication, and prior inventions.

Judge Townsend states that the complainant admits that every element in the invention existed in art before the combination was made, and he finds that there was a question in the Patent Office in 1879, as to whether patents could be granted to Field, because of a prior patent, known as the Clark, which embodied the same principle.

The Oconto Lamp Case.

The United States Circuit Court of Appeals handed down a decision on May 1 at Wilwaukee affirming the preliminary injunction granted by Judge Seaman against the Oconto Lamp Company, a full report of which appeared in our columns at the time.

The opinion, which was written by Judge Jenkin, after reviewing the law in regard to preliminary injunctions, both in relation to the lower court and the Circuit Court of Appeals, concludes that the former properly interpreted the rule applying, and that the latter has a right to review to the fullest extent the decision of the lower court.

The conclusion of the court is based upon grounds not conclusive of the fact of Mr. Goebel's alleged prior invention, but effective in the consideration of the question whether the case presented is so clear and satisfactory that it overcomes the presumptive force, which, under the rule adopted, must be conceded to the patent. Two grounds are named.

The first is that the evidence offered in favor of the Goebel defense as to his prior invention of the incandescent lamp is entirely ex parte, and that the court cannot accept the doctrine that ex parte evidence can be relied upon to establish the very improbable claim of Goebel.

The second circumstance is that the story of the invention is rendered more improbable by the fact that Goebel never attempted to take out a patent, because he well understood, as shown by applications for patents on other inventions, the protection to be derived from such an action.

The court concludes that without assuming to say that the story of this invention is untrue, and without designing to suggest what result should be reached upon final hearing, it is compelled to say that the story is surrounded by such an atmosphere of improbability that until it shall have been thoroughly sifted and sustained upon final hearing, the claim ought not to be permitted to invade the monopoly accorded another for the same invention, whose claim has passed safely the ordeal of judicial scrutiny. The court below, therefore, well held that the patent of Mr. Edison should be protected from invasion pendente lite, and the order appealed from is affirmed.

ELECTRICAL FEATURES OF THE MIDWINTER FAIR

The most conspicuous feature of the Midwinter Fair is the Bonnet tower, which stands in the centre of the ground court or plaza. This graceful structure is seen by the visitor long before he enters the grounds, and the light from the mammoth searchlight which crowns its top, under proper atmospheric conditions, is visible more than 100 miles away. The level of the court upon which the tower stands is depressed some ten feet below the level of the ground upon which the main buildings rest. Upon this higher level is also the principal roadway and the cement walk, which main thoroughfare together form the and promenade for the visitors.

As seen from this elevation, the tower, when illuminated at night, offers a view of surpassing beauty, some idea of which is given in the illustrations. These cuts are reproduced from original photographs taken by Mr. Joseph E. Mullenden, of Taber & Co., for the souvenir album soon to be issued by the San Francisco "Examiner," and through the courtesy of that paper they were secured by the special representative of The Electrical World. As night views the photographs are perhaps the finest that have ever been taken, and show in a marked manner the excellent photographing qualities of the electric light.

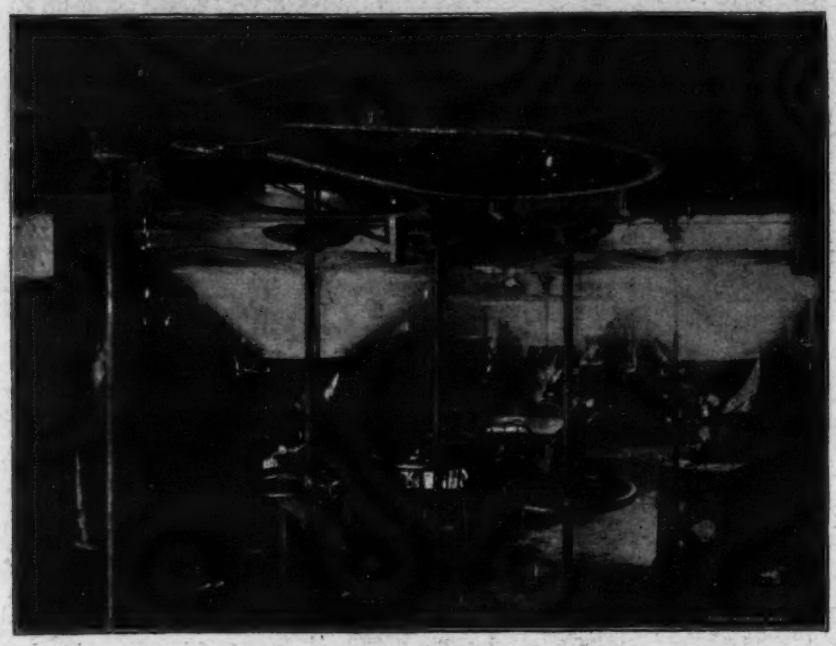
The contract for the lighting of the tower was awarded to the Western Electric Company, and all the details of the design of its illumination and of the electrical construction were placed in the hands of that company. The tower rises 265 feet from the level of the court and 3,260 incandescent lamps of 16 c. p. were utilized in its decoration. Of these about 1,000 were employed for outlining the tower, 1,000 for the fixed decorative light effects and 1,260 in the changing geometrical designs placed midway between the different platforms of the tower. Current is supplied to the tower by rubber covered conductors placed underground in wooden conduits. The general distributing point of the dynamo circuits is located in one of the booths of the kiosks under the tower, where the conductors terminate. The controlling switchboard is also located here. The automatic switch which controls the geometrical designs was very completely described in the last section of this article.

ILLUMINATION OF THE ADMINISTRATION BUILDING.

In carrying out the electrical construction work it was necessary to bear in mind the necessity of making it conform to the general design of the structure so as not to impair its delicate outlines. This was accomplished by mounting the lamps upon wooden strips where the lights followed the principal lines of the tower. In the case of the geometrical designs it was necessary, however, to devise some other means. This was very successfully accomplished by the use of wire netting of about one-inch mesh stretched on frames, the lamps being supported by means of two wooden discs clamping the wire netting, the discs being scarcely larger than the base of the lamp sockets employed. The frames with this wire netting were raised and fastened to the sides of the tower by means of clamps and steel tie wires.

In the daytime it is scarcely possible to see the electrical features of the tower, as its graceful outlines have been per-

fectly preserved. On the extreme top of the tower is the large searchlight which was mentioned in these columns last week. The brilliant effects of its rays may be seen in the accompanying illustration.



INTERIOR OF STIERINGER FOUNTAIN WHILE IN OPERATION.

An electric elevator carries passengers to the third platform, which is about two hundred feet from the ground.

The Fort Wayne Company, through its local agents, was among the first to come to the relief of the fair committee, and offered two 60-light arc machines, which are now used for lighting the central court. Later the company, through the Chicago headquarters, made a further contribution of a large alternator of 3,500 lamps capacity. It has 24 poles, and furnishes current for lighting the Administration Building, Festival Hall and the general offices of the exposition. It is by no means the least important of the exhibits, its neat appearance and location on the main aisle, where it runs all day, causing it to be examined by many visitors. Views are given of this machine and the company's arc dynamos, which are located near it.

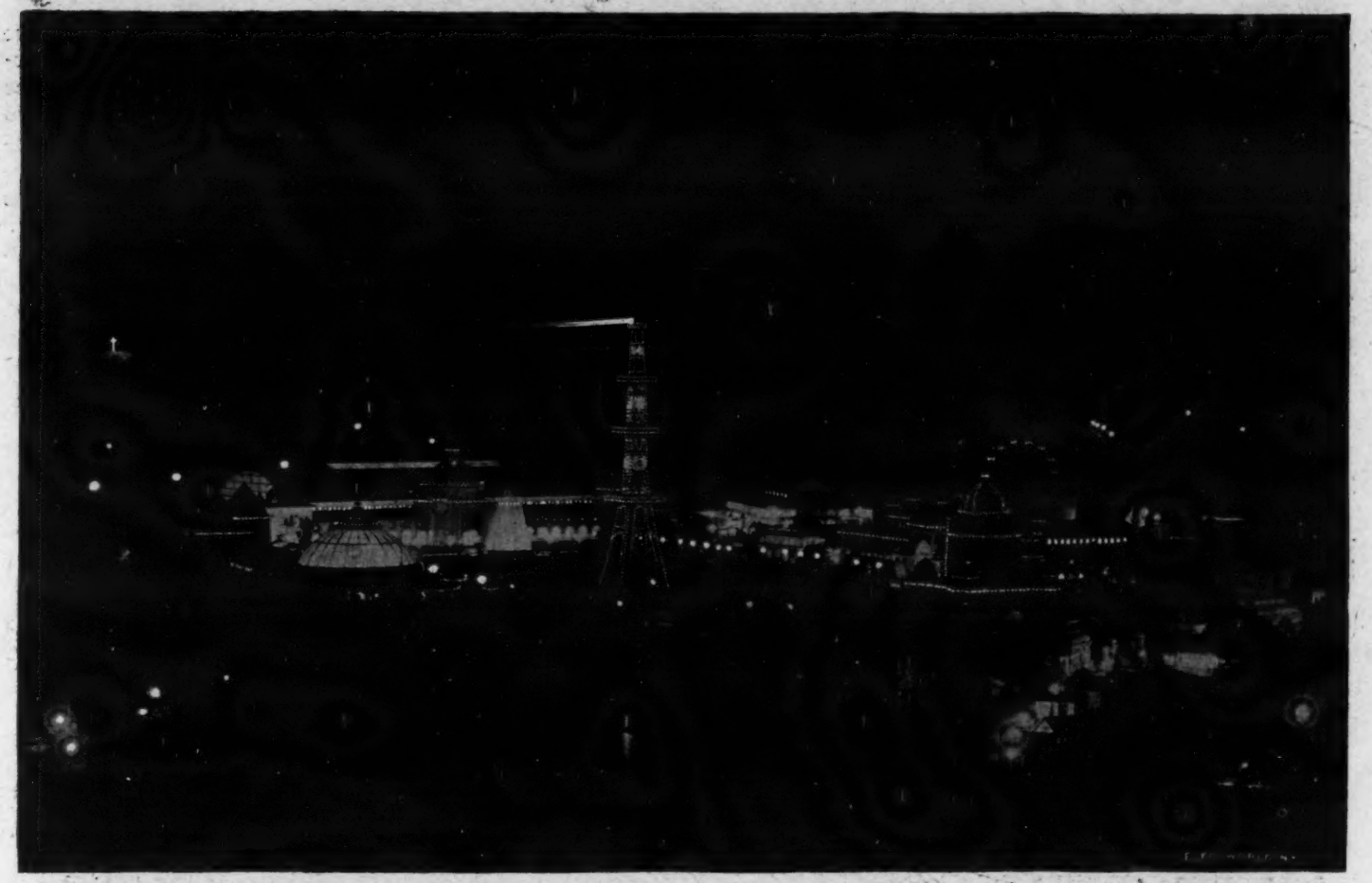
The local agents, the Electric Improvement Company, who came to the front at an opportune time, when some encouragement was necessary in order to induce others to assist, deserve credit for their faith in the outcome of the undertaking.

The only other company furnishing machines for lighting purposes is the Standard Electric Company, which has four 50-light arc dynamos used for the illumination of the Arcade, Horticultural Hall and part of Mechanical and Liberal Arts Building.

All companies furnishing machines also supply the lamps and apparatus necessary for making them operative.

The Siemens & Halske company offered a 6,000-light machine, but no suitable engine could be obtained for running it, and the offer was regretfully declined.

THD MANUFACTURES AND LIBERAL ARTS BUILDING.



THE MIDWINTER FAIR AT NIGHT.

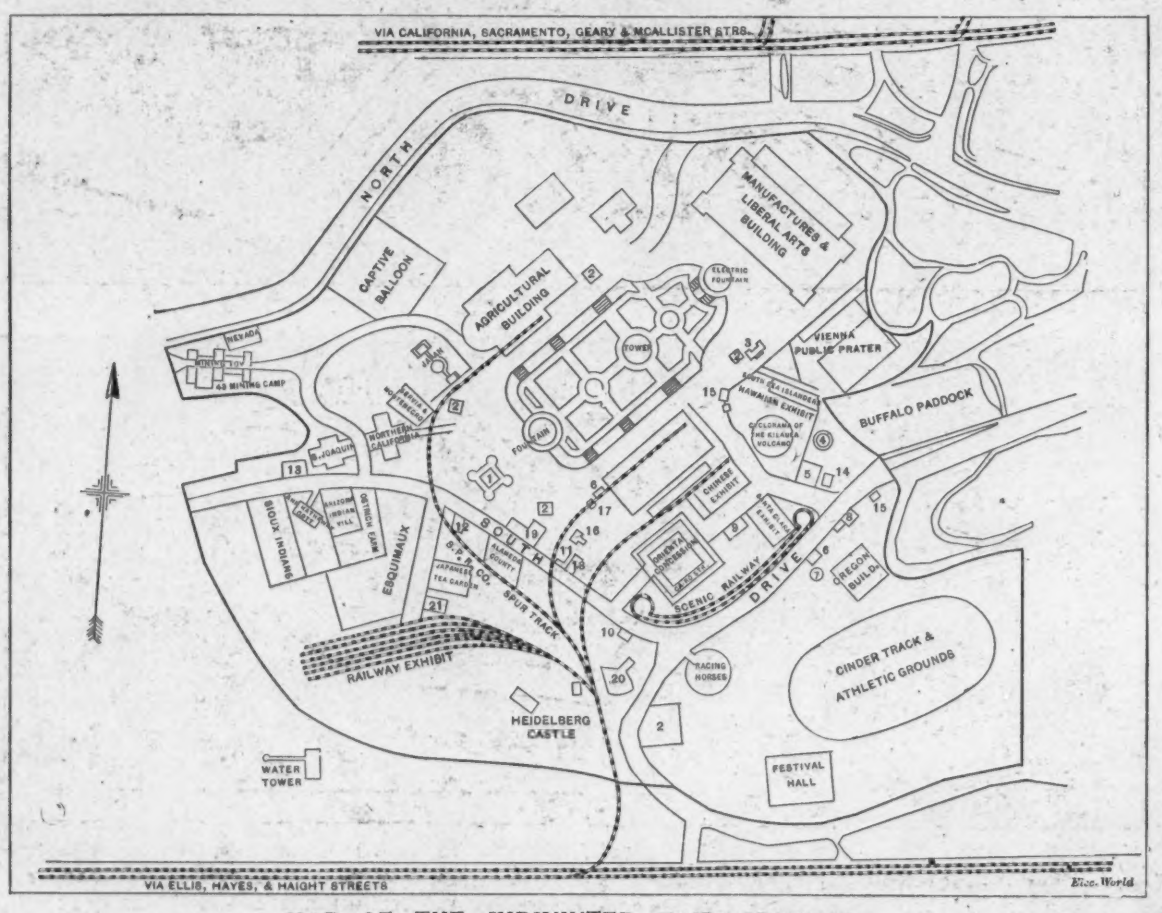
None of the foreign exhibitors at Chicago considered it worth while to make any display here, and the electrical manufacturers of the coast have felt that it was unnecessary for them to show what they can do.

The tower is fitted with a Hale elevator, which is run by an Eickemeyer motor. This motor can scarcely be considered an exhibit, as it is placed in a dark room under the tower, the only access to which is by means of a steep stairway, the door of which is usually closed. The elevator and machinery is the same one that was in use at the World's Fair, running to the roof of the Manufactures Building. After the Chicago Exposition it was purchased by the Bonet Tower Company and brought to San Francisco. The motor requires 20-kw. electric power when the elevator is loaded with 15 people, and it raises the loaded car a distance of 220 feet in one minute.

Perhaps one of the smallest electrical exhibits excites the most wonder amongst the rural visitors. In Machinery Hall is a cascade run in connection with a rotary pump exhibit, trician W. F. C. Hasson, and to him is largely due the success achieved. There are altogether 2,300 lamps on the cornices of the main buildings, the distance apart being two feet. This distance was found to be as close as was necessary, and from no very great distance the tower has the appearance of a pillar of light, and the cornices appear as though wreathed in continuous luminous lines.

In attempting to give some idea of the difficulties encountered, nothing better can be said than to give some quotations from an article by Mr. Hasson in the "Overland Monthly" for April, 1894, as he had all data at hand, and the difficulties overcome were still fresh in his mind when the article was written: He says:

"The General Electric Company contracted to wire the main buildings for the exterior decorative lights, and it was a daily struggle on the part of the wiremen to accomplish more than painters, plasterers and carpenters could destroy. The utilization of a railway generator for this lighting involved the adoption of a series system of arranging lamps.



MAP OF THE MIDWINTER FAIR GROUNDS.

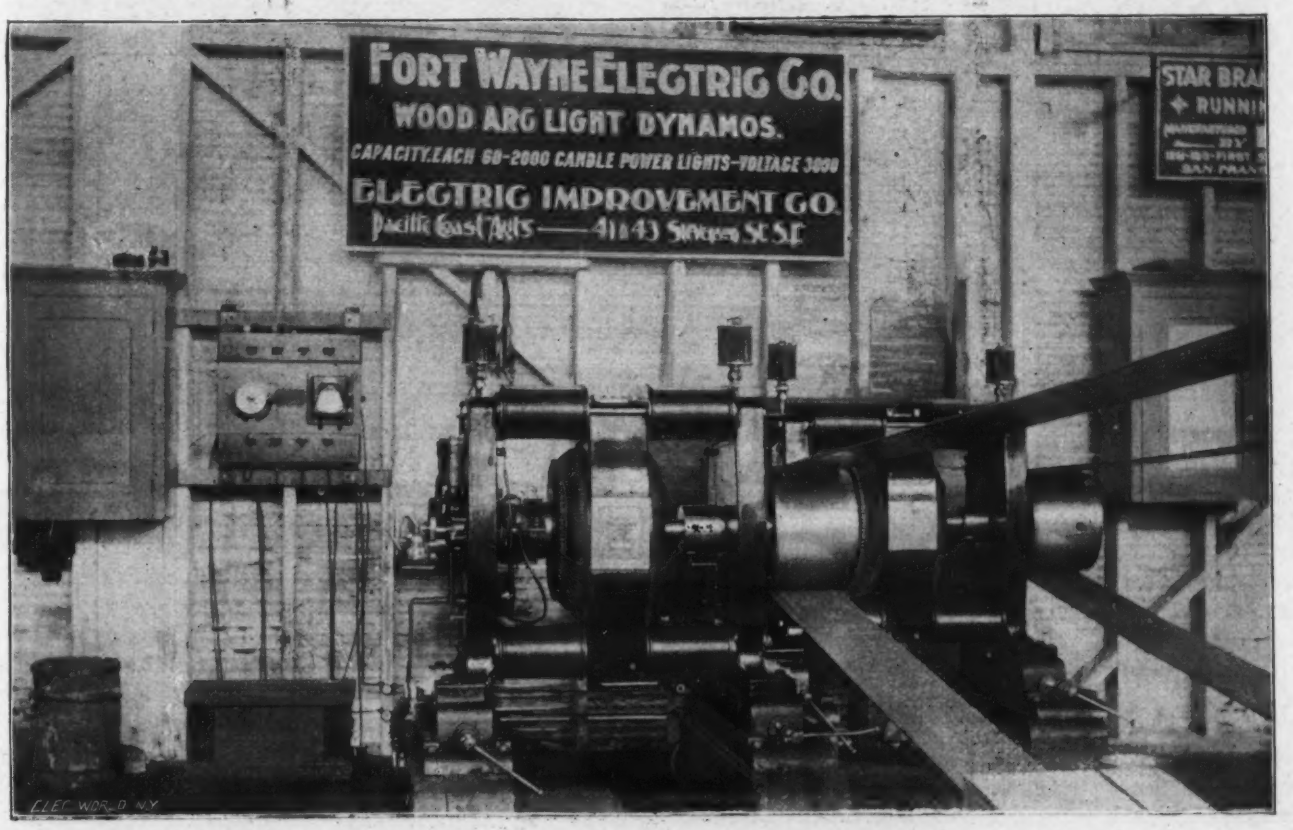
and placed behind glass shields are a number of colored lamps, which have the appearance of being in the water when viewed from a distance, and visitors from the interior can frequently be seen gazing with open-mouthed wonder at burning lamps, which do not appear to be affected by water. They seem to think there is something wrong about their previously entertained ideas of fire and water.

The lighting of the grounds, exteriors of buildings, etc., was a problem requiring considerable ingenuity, to produce the best results with the least possible expense. The number of lamps allowable was much less than was desirable, as is evident from the fact that the Western Electric Company estimated that 8,000 lamps would be required to light the tower effectively, while but 3,213 were placed upon it, and the number on other structures had to be similarly limited. Nevertheless the result is very effective. All lighting of buildings and grounds was under the charge of Chief Elec-

The system was accepted only on acount of the economic wiring it presented, and grave doubts existed concerning its success. Salt spray had ruined lamps and corroded sockets. The first test was a dismal failure. Simple but effective measures were adopted to remedy the numerous troubles thus caused, and these lights now stand permanently successful. . . . When Assistant Electrical Engineers Sprout and Meredith started with three laborers, about the middle of December, to plant poles around the central court, the prospect of getting the lighting plant installed looked very dim. Not a single engine or dynamo had been received on the grounds, no foundation had been built, the buildings offered little protection from the weather, work was barely started on the boilers and the annex to Machinery Hall was still a matter of conjecture. . . . Jan. 13 it was finally decided to officially open the Exposition on the 27th. The boilers were not yet installed, not a single engine was ready

for test, no line wire was strung. . . . Jan. 21 a single arc light was offered as a harbinger of the future. . . . and pressure was not again obtained until Jan. 25, when 12 arc lights were put in operation. Three arc dynamos broke down under test. On the evening of Jan. 26 200 lights were in circuit, and on Saturday, Jan. 27, poles had been erected, over 120,000 feet of wire strung and 600 arc lamps hung and put in successful operation. The number of men employed in the Electrical Department during this period never exceeded 35. . . . The lighting of the Exposition is in no sense a great engineering undertaking. It is notable, only that in a very short space of time a hastily constructed steam plant and an ill assorted set of untried engines and water soaked dynamos were put in successful operation without a single serious accident. Up to the day of opening not a single skilled employe of the Electrical Department received anything but laborer's wages. These men worked with intelli-

3,500-LIGHT WOOD ALTERNATOR.


FORT WAYNE ELECTRIC CO.
WOOD ARC LIGHT DYNAMOS.
CAPACITY EACH 60-2000 CANDLE POWER LIGHTS—VOLTAGE 3000
ELECTRIC IMPROVEMENT CO.
Pacific Coast Agts — 41 43 Stevenson St. S.F.

A CORNER OF THE ARC LIGHT EXHIBIT.

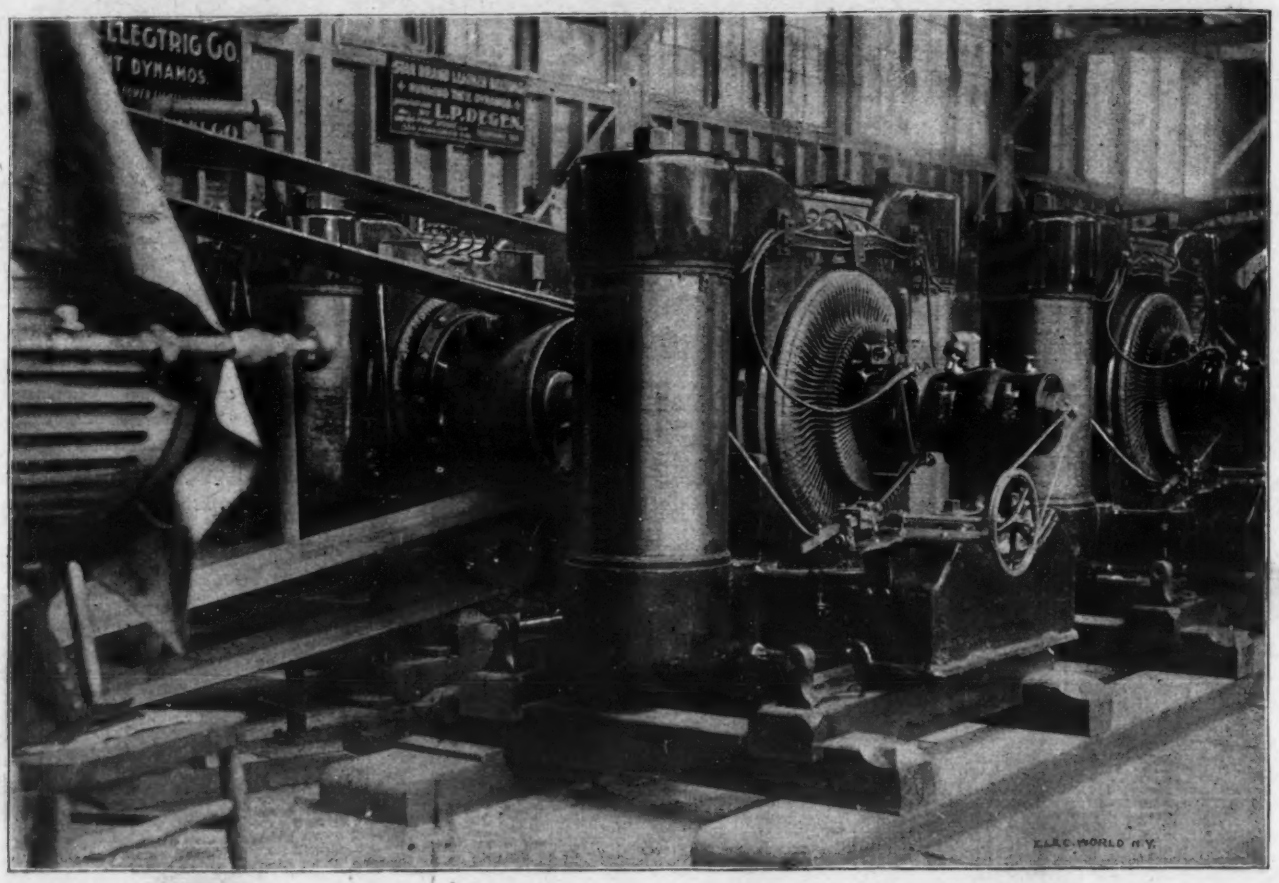
gence and enthusiasm; no work was too hard; no hours too long. To them belongs the credit of the successful lighting of the Exposition."

Mr. Hasson is enthusiastic in praise of his subordinates, but it is the consensus of expressed opinion that a large part of the success is due to the personal hard work of Mr. Hasson himself.

Although the electric fountain is the same one used in Chicago, the effect here produced is far more beautiful, no doubt owing to the more favorable surroundings. In Chicago everything was on such a large scale that the effect of the fountains was much dwarfed. The brilliant illumination of the Administration, Electrical and other buildings, the constant play of the great searchlights, made a flood of light in which the effect of the fountains was much lessened. Here, however, the beauty is much more pronounced, because, while the illumination of the grounds and buildings is really very fine, yet the much less magnitude causes the fountain to appear large in proportion. The effect is still over the mountains than for the use of the villagers. Just under the bridge a waterfall gives movement and sound to the otherwise restful and silent scene.

The curtain rises at that hour, darkest before the dawn, when all life is at its lowest ebb. All is silent, and darkness reigns supreme except for the twinkling lights of the village streets and of the bridge. Soon the first flush of dawn appears, the sky reddens and brightens (going through its accustomed shades in a very natural manner), and the clear sunlight floods the scene. The sun itself cannot be seen at this stage, as it is supposed to be hidden from the audience by a great spur of the mountain.

Shortly after sunrise the sky darkens with a great black cloud, which shuts out the light until almost the darkness of night prevails in the deep and narrow canyon, and lightning flashes and thunder rolls. With the passing of the cloud the scene brightens and the sharp zigzag lightning flashes are replaced by the glow that denotes lightning in the distance. Soon the sun comes out again in a clear sky, runs



STANDARD ARC LIGHT DYNAMOS.

further enhanced by extinguishing the tower lights, the decorative cornice lights on the main buildings and all arcs in the neighborhood of the fountain while it is playing.

It is not the intention of the exposition to conduct any tests as to efficiency of dynamos, or economy of lamps, engines or boilers. This would be desirable, but the conditions are not such as to make it possible.

In addition to its exhibits, the Western Electric Company has a scenic theatre in which very pretty and realistic effects are produced by an ingenious arrangement of electric lamps and methods of controlling them.

The scene represents a canyon, high up on a mountain side, through which flows the small stream which has eroded it. The rocks overhang the sides in great spurs, and on the rocky shelves under these overhanging crags is built a mountain village divided into two parts by the bed of the stream. A little higher up the canyon a great bridge has been thrown across, apparently more for the purpose of a highway its accustomed course and evening falls. The sunset glows appear, and as the last reds become dim, the stars begin to appear in the strip of sky at the head of the canyon, and the lights of the bridge and street lamps twinkle in a familiar manner, while the soft glow from the open doors and windows of the houses tells of quiet home life, far from the turmoil and strife of the great world.

This is the course the scene is supposed to follow, does follow sometimes, and would always but for the fact that man is not without his little failings. Sometimes during the thunderstorm the cloud is allowed to become too thick and the darkness in the canyon becomes fully as dense as during that "darkest hour before the dawn" with which the scene opens; at other times the lightning is turned on and not noticed until the audience has been for some time edified by the sight of stationary and permanent lightning flashes, during the continuance of which the thunder forgets to roll. Again at other times the thunder rolls without any reference

to the lightning, and continues to roll with undiminished volume during the soft glow that denotes lightning at a great distance. Sometimes as evening comes on the stars forget to come out, and when finally they remember that they are not up they come out with a snap that is really startling. As the thunderstorm clears away a very realistic rainbow appears, but sometimes it gets in a hurry and shows as a brilliant band of color while the lightning is still flashing, the thunder rolling and the canyon is still clothed in that "darkest hour" darkness. These little mishaps are, however, the exception rather than the rule, and one can really pass a pleasant few minutes looking at a very pretty scene.

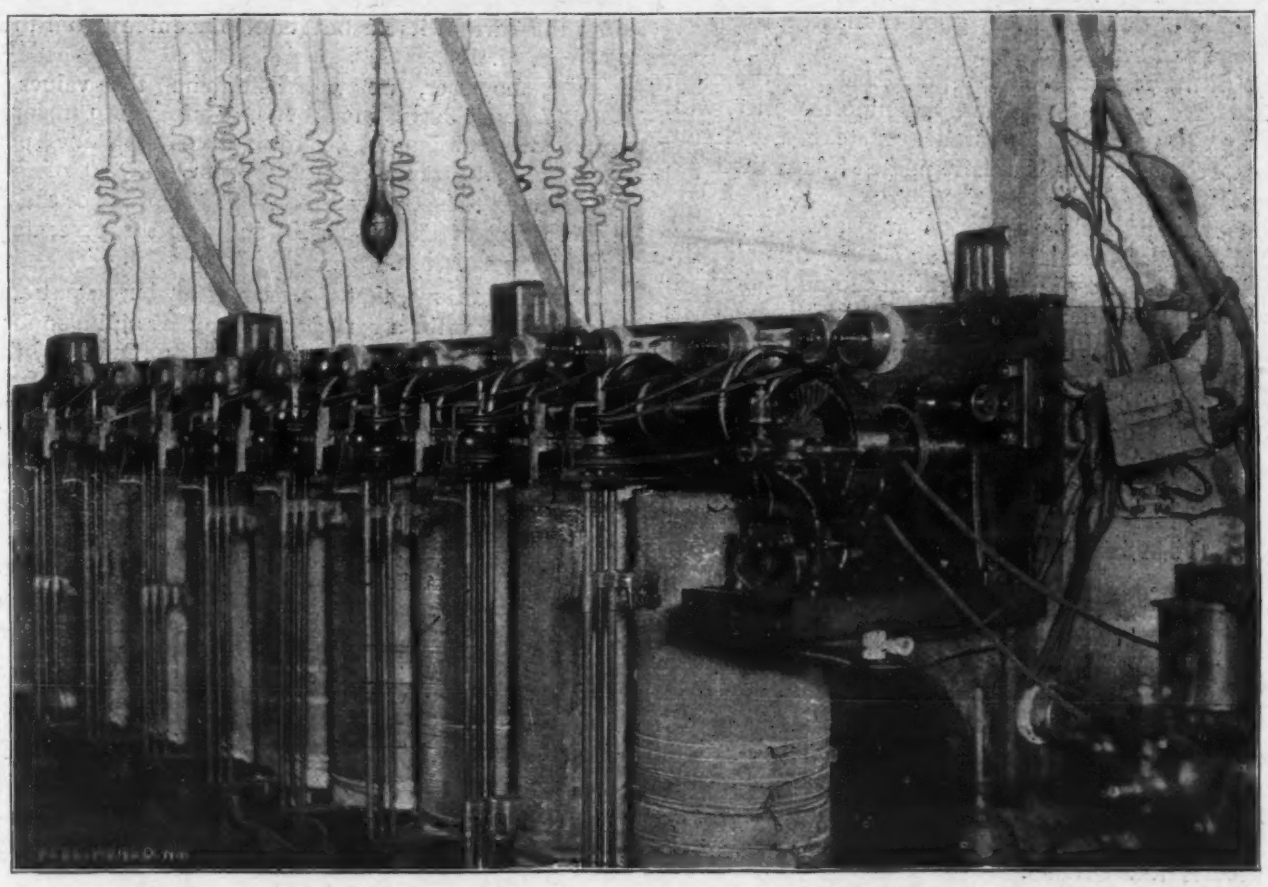
To produce the various color effects, groups of colored lamps are suitably placed and connected in series with rheostats, by means of which the degree of illumination can be controlled. The grouping of the lamps is as follows: Set at the back of the stage and close against the curtain representing the sky at the head of the canyon, are two groups of red lamps and two similar groups of blue ones, one group of each being placed on each side of the stage, representing the east and west. Higher up and considerably more to the front are similar groups of red and blue lamps, and four more such groups are found in the flies directly over the curtain of the stage.

The sun is located directly over the front of the stage, and consists of a group of 15 32-c. p., 80-volt lamps run on a 110-volt circuit. The lamps are set as close together as possible and produce a very bright light, having considerable diffusive power.

The moon, of course, follows the same course as the sun, and is composed of a group of five 32-c. p. green lamps, run at normal candle power (probably a more nearly perfect moonlight effect would be produced if the lamps were indigo instead of green). Behind the screen at the back of the stage is a narrow space lighted by 35 16-c. p. lamps, and the light from this space, shining through holes in the screen, forms the stars.

In the ceiling flies and on the sides there are altogether 125 32-c. p. blue lamps and 150 16-c. p. red lamps. In addition to these red lamps the sun, when the lamps first begin to brighten, is behind a red screen on one side of the stage, and is drawn behind a similar one on the other side as the lamps darken, thus adding to the red glow at dawn and sunset. As looked at from the audience seats, east is on the left of the stage.

The rheostats being in series with the various groups of lamps, the sun lamps and the red lamps in the east and in the ceiling flies are thrown into circuit. The motor controlling the rheostats is started, and as the resistance is gradually cut out of circuit, the lamps brighten and produce the red glow at dawn; at the same time a motor is started that slowly draws the sun from east to west. As the sun begins to emerge from behind its red screen, the groups of red lamps in the east and overhead are gradually dimmed by throwing a clutch lever, by means of which the direction of motion of a traveler on the rheostat is reversed, and resistance gradually cut in. At the same time the various groups of blue lamps are thrown in circuit, and gradually brighten as the red lamps fade. By the time the sun is fully clear of its screen, the reds are extinguished and the blues burning full power. The sun continues its motion, and passes from east to west until it reaches the red screen at the west. As it begins to disappear behind this, the resistance is gradually thrown in circuit with the blue lamps, while the reds overhead and in the west begin to light up, producing the evening glow. Finally these western reds and the sun lamps begin to fade, and as they disappear the stars light up and the moon rises. The object of the blue lights with the bright sunlight is to produce clear daylight effects, and if they are not thrown in at the proper time a hazy, muddy effect is produced, like a sky covered with leaden clouds. When the thunderstorm is coming on these lamps are first cut out through the rheostats, and then the sun is darkened.



SCENIC THEATRE CONTROLLING APPARATUS.

Lightning is produced by making some scratches on a

piece of japanned glass, several such being used to produce flashes of different shapes. The glass is slipped along until a scratch comes before a stereopticon lens in the company's well-known theatre focusing lamp. Light is flashed through it by means of a pneumatic shutter, similar to that on a camera.

The rainbow is produced by using a small semi-circular prism in front of an ordinary focusing lamp. The gradual brightening is produced by slowly shoving forward a cloth screen, which is made with a decreasing number of thicknesses, so as to permit the passage of more and more light, thus producing the same effect as a rheostat used in connection with an incandescent lamp.

Heat or glow lightning is produced by breaking a 5-ampere current with a file, the current being regulated by having five 32-c. p. in parallel in the circuit. The first time it was attempted to produce the effect no lamps were used, and a dead short circuit was produced, which made a fine lightning effect, but blew a 100-ampere fuse. A piece of sheet zinc, well shaken, produces a very good thunder.

The village and bridge lamps are 1-4 c. p., and are placed on models of the regular arc lamp poles made by the company. They are 3-volt lamps and run nine in series, with three 32-c. p., 80-volt lamps in parallel on a 110-volt circuit. They take three amperes, which is regulated by the three 32-c. p. lamps.

The houses are lighted by a 16-c. p. lamp, placed behind a screen, which covers the lamp, but has an opening in the back so as to produce a different light in the houses.

A view is given of the rheostats controlling the various groups of lamps. Eleven rheostats, made of German silver wire, bedded in asbestos, are placed in a row, and each controls a group of lamps. A board is shown, firmly secured to uprights behind these rheostats, to which is secured a shaft, which runs the entire length. This shaft is driven continually in one direction by the motor shown, and carries a series of grooved pulleys, each having beside it a smaller loose pulley, which turns freely on the shaft. A continuous belt passes over each such pair of pulleys and over two small ones set on a vertical shaft in a frame just in front and over a rheostat, as shown, thus giving these two pulleys motion in opposite directions. The handles shown connect with clutches, by means of which the vertical screws shown in front of each rheostat can be connected with either of the two pulleys, and thus be made to revolve in either direction. These screws carry travelers, as shown, which, as the screws revolve slowly, move contacts over the bared portion of the rheostats. The switches on the board above the shaft connect with the various circuits.

(To be continued.)

Magnetic Separator Patents.

Judge Coxe at the April term of the United States Circuit Court, held in New York, entered an interlocutory decree on final hearing in favor of the complainants in the suit of the Magnetic Separator Company against William D. Hoffman. It was declared that the defendant infringed patents, the property of the Magnetic Separator Company, and granted to Clinton M. Ball and others, by making, using and selling systems or plants for the concentration of iron ores, as exhibited and operated at the Clover Hill mines and Croton magnetic mines, Westchester County, New York, at the mines of Wetherbee, Sherman & Co., near Port Henry, New York, and at the mines of the Chateaugay Ore and Iron Company, Clinton County, New York. The Court decreed the payment of profits derived from such infringement by the defendant, any damage sustained thereby and the costs of the suit, and also enjoined the defendant from further infringement.

The Practical Importance of Resonance in the Transmission of Electrical Power.—II.

BY F. W. DUNBAR.

THE fundamental equations required having now been deduced, we may discuss the problem of the construction of a circuit of a given length which is to transmit power at a certain alternating voltage, so that for a given weight of copper the power delivered at the distant end shall be a maximum and the percentage loss upon the line a minimum.

As the power transmitted is equal to $\frac{I\ V}{2}\cos\theta$, where I and V are the maximum values of the current and voltage, respectively, during one cycle, and θ is the angle of lag between the current and voltage, we must not only consider the current itself, but its displacement from the phase of the E. M. F.

First, however, we will determine the values which C and L must have in order to bring into resonance a circuit of given length, l, and of given resistance per mile, R, which is to transmit an alternating current of N cycles per second. Then we will consider the phase of the current with respect to the E. M. F., and also the percentage loss during transmission.

If the conditions, that the current at the distant end shall be a maximum for a certain value of L and also for a certain value of C, are imposed upon equation (11), then the values of C and L which satisfy the conditions $\frac{dI}{dC}=0$ and $\frac{dI}{dL}=0$, must be determined in terms of the other constants of the equation—i. e., the length, resistance and rate of alternation.

We will first make $\frac{dI}{dL}=0$ and solve for L

$$I=\frac{E}{\left(\frac{\sqrt{R^2+L^2\omega^2}}{C\omega}\right)^{\frac{1}{2}}}\sqrt{\frac{2}{\cosh p\,l-\cos a\,l}}$$

I will be a maximum with respect to L when $\sqrt{(R^2+L^2\omega^2)^{\frac{1}{2}}}(\cosh p\,l-\cos a\,l)$, or $1/2\log(R^2+L^2\omega^2)+\log(\cosh p\,l-\cos a\,l)$ is a maximum. Hence

$$\frac{dI}{dL}=0=\frac{L\omega^2}{R^2+L^2\omega^2}-\frac{\frac{l\,p\,\omega}{2\sqrt{R^2+L^2\omega^2}}\sinh p\,l-\frac{l\,a\,\omega}{2\sqrt{R^2+L^2\omega^2}}\sin a\,l}{\cosh p\,l-\cos a\,l}$$

$$\text{or}\quad\frac{L\omega}{(R^2+L^2\omega^2)^{\frac{1}{2}}}=\frac{a\,l}{2}\left\{\frac{\frac{\sinh\frac{a\,l}{\tan\mu}}{\tan\mu}-\sin a\,l}{\cosh\frac{a\,l}{\tan\mu}-\cos a\,l}\right\}\qquad(12)$$

Also equating $\frac{dI}{dC}$ to zero, we have that

$\sqrt{\frac{C\omega}{\cosh p\,l-\cos a\,l}}$ or $\log C\omega-\log(\cosh p\,l-\cos a\,l)$ will be a maximum when I is a maximum.

$$\text{Hence}\ \frac{dI}{dC}=0=\frac{1}{C}-\frac{l\omega\sqrt{(R^2+L^2\omega^2)^{\frac{1}{2}}-L\omega}\sinh p\,l+L\omega\sqrt{(R^2+L^2\omega^2)^{\frac{1}{2}}+L\omega}\sin a\,l;}{(\cosh p\,l-\cos a\,l)4\sqrt{\frac{C\omega}{2}}}$$

$$\text{or } \frac{a\,l}{2} = \frac{\cosh \frac{a\,l}{\tan\,\mu} - \cos a\,l}{\sinh \frac{a\,l}{\tan\,\mu} + \sin a\,l}. \qquad (13)$$

Combining (12) and (13), we have

$$\frac{L\,\omega}{(R^2 + L^2\,\omega^2)^{\frac{1}{2}}} = 1 - \frac{2 \sin a\,l}{\sinh \frac{a\,l}{\tan\,\mu} + \sin a\,l} \qquad (14)$$

which is the condition which will yield a maximum current at the distant end of a circuit of length l, resistance R and period ω — that is, it is the condition of "resonance" of the circuit.

This equation may be solved as follows:

If $\frac{x}{y}$ be any small angle, then $(\cosh \frac{x}{y} - 1) = \frac{x^2}{2\,y^2}$, and as the angle increases $(\cosh \frac{x}{y} - 1) > \frac{x^2}{2\,y^2}$.

Also if $\frac{x}{y}$ be any small angle, then $\sin \frac{x}{y} = \frac{x}{y}$, and as the angle increases $\sinh \frac{x}{y} > \frac{x}{y}$ and increases more rapidly than does $(\cosh \frac{x}{y} - 1)$. Therefore

$$\frac{\cosh \frac{x}{y} - 1}{\frac{x}{2\,y} \sinh \frac{x}{y}} < 1, \text{ and equals 1 when } y \text{ is large.} \qquad (15)$$

$$\text{Hence } \frac{\cosh \frac{x}{y} - 1}{\sinh \frac{x}{y}\ \frac{x}{y}} < \frac{x}{2}, \text{ or } \frac{\cosh \left(\frac{a\,l}{\tan\,\mu}\right) - 1}{\sinh \left(\frac{a\,l}{\tan\,\mu}\right)} < \frac{a\,l}{2}.$$

$$\tan\,\mu$$

If the numerator of the left-hand member be increased by $(1 - \cos a\,l)$ and the denominator increased by $\sin a\,l$, both members become identical with equation (13). But as $(1 - \cos a\,l)$ is always less than $\sin a\,l$ for all positive values of $a\,l$ less than 45°, it is evident that

$$\frac{\cosh \frac{a\,l}{\tan\,\mu} - \cos a\,l}{\sinh \frac{a\,l}{\tan\,\mu} + \sin a\,l}$$

can never equal $\frac{a\,l}{2}$ if $\sin a\,l$ is positive. But $\sin a\,l$ cannot be negative; otherwise the second member of equation (14) would become greater than unity, which is impossible, as $(R^2 + L^2\,\omega^2)^{\frac{1}{2}}$ is always greater than $L\,\omega$.

Hence the only values which $\sin a\,l$ and $\cos a\,l$ can have and satisfy equations (12), (13) and (14) are $\sin a\,l = 0$ and $\cos a\,l = +1$.

The conditions then which will bring a circuit of any length and any resistance into resonance and thus yield a maximum current for a given rate of alternation are

1. $a\,l$ shall equal $2\,\pi$ or some multiple of $2\,\pi$.
2. $\frac{a\,l}{\tan\,\mu}$ shall be equal to .2 or less.

This latter condition is imposed directly by equation (13), which, as stated, is only true when not only $\sin a\,l = 0$, but when $\frac{a\,l}{\tan\,\mu}$ is so small that the quantity

$$\frac{\cosh \left(\frac{a\,l}{\tan\,\mu}\right) - 1}{\frac{a\,l}{2\tan\,\mu} \sinh \left(\frac{a\,l}{\tan\,\mu}\right)}$$

is practically equal to unity.

When $\frac{a\,l}{\tan\,\mu} = .1$ this quantity is equal to .999 and when $\frac{a\,l}{\tan\,\mu} = .2$ it has decreased only to .988.

The difference becomes rapidly more marked above this value of $\frac{a\,l}{\tan\,\mu} = .2$, and the value .2 has been chosen as the maximum value which will yield practically perfect resonance, although, as we shall see, it may have a considerably greater value and still not throw the line completely out of resonance.

By the second condition then $\tan\,\mu$ must exceed five times the value of $a\,l$ or must exceed $10\,\pi$, $20\,\pi$, $30\,\pi \ldots n\,10\,\pi$, depending upon whether the circuit has 1, 2 . . . n complete wave lengths.

$$\text{But } \tan\,\mu = \frac{a}{p} = \sqrt{\frac{(R^2 + L^2\,\omega^2)^{\frac{1}{2}} + L\,\omega}{(R^2 + L^2\,\omega^2)^{\frac{1}{2}} - L\,\omega}}$$

$$= \cot \cos^{-1} \frac{L\,\omega}{(R^2 + L^2\,\omega^2)^{\frac{1}{2}}} = \tan \frac{\left(90° + \tan^{-1} \frac{L\,\omega}{R}\right)}{2},$$

$$\text{or } \mu = \frac{\left(90° + \tan^{-1} \frac{L\,\omega}{R}\right)}{2} \qquad (16)$$

This may be written

$$90° - \omega = \frac{90° - \tan^{-1} \frac{L\,\omega}{R}}{2}$$

and μ is a large angle, as its tan is large. But we know that the tangents of large angles vary as (90° — these angles), hence

$$\tan\,\mu = \frac{2\,L\,\omega}{R} \text{ or } L\,\omega = \frac{R \tan\,\mu}{2}. \qquad (17)$$

Therefore, the second condition may be written $L\,\omega$ must exceed $(5\,\pi, 10\,\pi \ldots n\,5\,\pi)\,R$ depending on whether there be 1, 2 . . . n wave lengths in the circuit.

The corresponding values of $C\,\omega$ may be found directly rom the relation

$$a = \sqrt{\frac{C\,\omega}{2}}\ \sqrt{(R^2 + L^2\,\omega^2)^{\frac{1}{2}} + L\,\omega}$$

$$= \sqrt{C\,\omega}\ \sqrt[4]{R^2 + L^2\,\omega^2} \sin\,\mu.$$

But as $\tan\,\mu$ always exceeds $10\,\pi$, $\sin\,\mu$ is never less than .999, or is practically unity. Again, as $L\,\omega$ must exceed $5\,\pi\,R$ the value $\sqrt[4]{R^2 + L^2\,\omega^2}$ differs from $L\,\omega$ by less than two-tenths per cent., and we may write

$$\sqrt{C\,\omega} = \frac{a}{\sqrt{L\,\omega}} \text{ and } a = \frac{2\,\pi,\ 4\,\pi, \ldots}{l}$$

hence

$$C\,\omega = \frac{4\,\pi^2\,n^2}{l^2\,L\,\omega}. \qquad (18)$$

where n = number of wave lengths.

The three equations then for perfect resonance in any circuit are

$$a\,l = 2\,\pi\,n, \qquad (A)$$

$$L\,\omega > 5\,\pi\,R\,n, \qquad (B)$$

$$C.\,\omega = \frac{4\,\pi^2}{l^2\,L\,\omega}\,n^2, \qquad (C)$$

where n is the number of complete wave lengths which the circuit is divided into.

Equation (A) is the fundamental equation of resonance.

Equation (B) expresses the proportion which must exist between the inductance, or weight or inertia of the circuit to the resistance or friction of the circuit in order that the resonance may be possible.

And equation (C) is simply equation (A) expressed with the condition of (B) included.

If now we were right in our supposition that by giving C and L certain definite values it should be possible to "tune" any circuit to any period of alternation, that is to make it resonant to that rate, then equation (C) should be identical with the equation expressing the law of the vi-

bration of any mechanical body, as an organ pipe or piano string.

(C) may be written $\omega = \frac{2\pi n}{l\sqrt{CL}}$, but $\omega = 2\pi N$, where N is the number of alternation per second, hence

$$N = \frac{n}{l}\sqrt{\frac{\frac{1}{C}}{L}}$$

But the law of the vibration of a mechanical body, as a piano string or our wire rope, is

$$N = \frac{n}{l}\sqrt{\frac{P}{M}}$$

where P is the elasticity and M is the inertia of the vibrating string.

Similarly $\frac{1}{C}$ is the electrical elasticity of the electrical circuit and L its inertia, and the two equations are identical in all respects.

We are then justified in assuming that all the phenomena accompanying the vibration of a mechanical string in a medium, as the air, in which the frictional resistance is small compared with the inertia of the string, can be reproduced electrically upon an electrical circuit where the inertia or inductance of the circuit is made large in comparison with the friction or resistance, or as equation (B) states, when $L\omega > 5\pi R n$, or when $L > \frac{5}{2}\frac{R}{N}$.

The process then of designing a line to be resonant to a certain period of alternation is, assume: $n = 1$, then L must be greater than $\frac{5}{2}\frac{R}{N}$ divided by the number of alternations per second. And $C = \frac{1}{N^2 4\pi^2 L}$.

If this should yield a value of C smaller than it is possible or practicable to obtain, say less than $\frac{.016}{10^6}$ farads for a No. 8 B. W. G. wire, then make $n = 2$, in which case the inductance and capacity will each be twice as great as before. If still too small make $n = 3$, in which case the inductance and capacity will each be three times as great as when $n = 1$, etc.

If, however, the value of C becomes so large that it would be expensive to secure it, then it is evident that L may be increased with advantage for as long as it is at least equal to $\frac{5}{2}\frac{R}{N}$ it may have any value such that $CL = \frac{1}{N^2 4\pi^2}$. Of course it is of advantage, to maintain $n = 1$ on short lines as the values of L and C may each then be small.

The methods by which L and C may be cheaply varied and the limits of these variations will be discussed later.

(To be continued.)

The Buckeye Electric Company Again Successful.

Judge Ricks, of the United States Circuit Court, for the Northern District of Ohio, on May 4 refused to grant a preliminary injunction against the Buckeye Electric Company, of Cleveland, Ohio, for infringement of the Edison incandescent lamp patent. The motion was made by counsel for the General Electric Company on the grounds that it now possessed valuable evidence which had not been presented when the court dissolved the injunction previously in force against the defendant.

The new facts disclosed by the affidavits are that at the time the owner of the patent and the assignee thereof made their application to the Patent Office, in October, 1883, asking for a limitation of the life of the patent, and at the time of the proceedings taken under said application, a contract was in force by which the owner of the patent had given the exclusive right to manufacture lamps under the patent to Edison, the patentee, and to certain persons whom the contract stipulated might be associated with him in that undertaking. The contract was made on the 8th day of March, 1881. On the 12th day of January, 1884, Edison and his associates named in the contract of March, 1881, assigned and transferred to the Edison Lamp Company, a corporation organized under the laws of New Jersey, all their title and interest in the said contract, and also all their interest in a second contract between the Edison Electric Light Company and the Edison Lamp Company, made October 11, 1883.

This right to exclusively manufacture lamps, thus vested in Edison and his associates, was in force when the owner of the patent and Edison joined in the Patent Office application of October, 1883. The associates of Edison in that exclusive right, it is claimed, were not advised of what Edison and the owner of the patent did with reference to the said proceedings in the Patent Office, were not bound thereby, and that, so far as their rights in that contract are concerned, they are not now estopped from claiming a preliminary injunction by any acts of the owner of the patent or the patentee.

The case is practically, therefore, the application of the holders of this equitable interest in the contract of March, 1881, for a preliminary injunction against the defendants. It has already been decided that the assignee of the patent and the patentee are not entitled to such relief. Those who now ask for the injunction upon the new facts disclosed must show their right to this remedy and relief by the same rules and upon the same principles governing any other applicant for such an order. Judge Jenkins finally concludes that the relations of those associated with Edison under the contract of March, 1881, were so close, and their interests so bound up in the success of the patent, that, accepting their denial of not having authorized the act limiting the life of the patent, yet such denial is not inconsistent with the contention of the plaintiff that they must soon after the act have obtained knowledge of it. Between October, 1883, and March, 1893, the indorsement in question appeared on every copy of the patent, and with their natural interest in that patent the court concludes they must have had knowledge of it.

While Edison estopped himself from claiming an injunction by his acts and conduct between October, 1883, and March, 1893, as found in the decision hereinbefore referred to, it does not follow that his associates were likewise estopped. But in this hearing it ought affirmatively to appear that those parties who claim a prior equity to the defendant were ignorant of, and did not participate in, or authorize, the several acts and the line of conduct which it has been held estopped the other plaintiffs from claiming relief against these defendants. This should appear so satisfactory as to justify the court in granting this unusual relief. The burden of proof is not on the defendant but on the plaintiffs, and the court concludes that the latter have not established their claim to a prior and superior equity not affected by the estoppal heretofore found.

In regard to the suggestion made by counsel for the General Electric Company that an injunction be allowed, and its operation then suspended, thus allowing the complainants to appeal the case, the court stated that while fully appreciating the disadvantage under which the complainants stand in being unable otherwise to appeal, yet the court has no right to thus impose on the defendants the burden and expense of prosecuting an appeal from an order allowing an injunction to which the plaintiff is not entitled. The motion for a preliminary injunction is therefore refused.

THE ELECTRICAL WORLD'S DIGEST

OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS BY CARL HERING

ELEC. WORLD, N.Y.

ELECTRO-PHYSICS.

Discharge Through Gases.—A Royal Institute paper by Prof. J. J. Thomson is abstracted briefly in the Lond. "Elec. Rev.," April 20. He observed the discharges by means of a rapidly rotating mirror in a discharge tube of 50 feet in length, in which the velocity at the positive electrode was said to be more than 100,000 miles per second, its progress being checked near the negative electrode, where there appeared to be a reluctance to enter the electrode; in one experiment the bulb contained two electrodes projecting some distance into the tube with the ends close together, showing that the spark did not pass from end to end, but started from the end and followed the gas in preference to the electrode, to the sealed-in end, an example of which is given; he deduced the conclusion "that the conductivity of gases at a certain degree of rarefaction was greater than that of any metal and almost infinitely greater molecule for molecule." At a higher degree of rarefaction, however, conductivity is diminished and in a perfect vacuum it is probable that the discharge would not pass at all; in another experiment he showed that electrical currents crossed a high vacuum quite freely, although they produce no glow to indicate the fact.

Electric Discharges.—In a French Academy paper by Mr. Piltchikoff, abstracted in the Lond. "Elec.," April 13, and more fully in "L'Ind. Elec.," April 10, he shows a new method for studying the electric discharge, in which one pole of an influence machine is attached to a metallic point, which is held over a layer of castor oil in a copper dish connected with the other pole, in which case the surface of the oil will be deformed differently under different circumstances.

Dielectric Hysteresis.—According to "L'Elec.," April 7, Mr. Kleiner has recently published the comparative researches concerning the heating of various dielectrics used in condensers; representing the energy dissipated in ebonite (hard rubber) by 1, that for paraffine was 0, mica 0.28, glass 0.74, rubber 1.41, colophane 0, wax 0.6, gutta-percha 0.76; no values for the electrostatic forces nor the frequency are given.

Peltier Effect.—According to an abstract in "L'Elec.," April 14, Mr. Houllevigue, in an Academy paper, gives a formula to find at a given temperature the difference of potential between the metal and the same metal in a given magnetic field.

Radiophone.—"La Lum. Elec.," March 31, abstracts an article by Mr. Semmola from the Italian, in which he describes some experiments with radiophones; the experiments of others were with gases and vapors, which were submitted to a thermic-radiation, transforming it into sound; in the present paper he shows that a solid can act in the same way, a fact which he claims is not generally known; in his experiment with a Hunning microphone, he shows that it is without doubt the simplest and most direct method.

Hydraulic Analogies.—In "La Lum. Elec.," March 17, Mr. Claude concludes at some length his paper on the subject mentioned in these columns before. A simple alternating current is represented by a vessel containing water connected with a flexible tube, the vessel being alternately raised and lowered; resistance and self-induction are shown by using a small and a large tube respectively; the effect of a capacity is shown by inserting a reservoir between the two vessels, containing an elastic diaphragm in its centre, which will yield to pressure but will transmit no liquid; a self-induction and capacity in parallel are shown by a combination of the two latter; resonance is shown in an apparatus like that for capacity, there being a stopcock in the thick tube, which is suddenly opened, thus producing an oscillatory current.

Conductivity of Discontinuous Conductors.—In "La Lum. Elec.," March 17, Mr. Branly discusses the recent article in the "Phil. Mag.," giving a resume of some prior similar researches made by himself.

Pressure in the Interior of Magnets and Dielectrics.—"La Lum. Elec.," April 7 and 14, contains a mathematical article by Mr. Lienard.

Propagation of Electricity.—An article by Mr. Poincare is given in "La Lum. Elec.," April 7.

Rapidity of Photo-Electric Phenomena.—The paper of Mr. Majorana is given in "La Lum. Elec.," April 7.

Synchronization and Resonance.—A theorem connecting the theory of synchronism with that of resonance by Mr. Cornu, is given in "La Lum. Elec.," March 31.

Work of Electromagnetic Forces.—A correction of an error in the paper of Mr. Pellat is given in "L'Ind. Elec.," April 10.

MAGNETISM.

Variation of Hysteresis with Temperature.—In a long article by Dr. Kunz in the "Elek. Zeit.," April 5, he describes in detail a long series of tests to determine the nature of the relation between the hysteresis loss and the temperature, having in a previous article two years ago shown that hysteresis varied with the temperature. Wires of different qualities were used and were magnetized in the form of a straight open circuit magnet, the iron being heated by means of an insulated coil of platinum wire, through which a current was passed, the temperatures being measured by a thermopile, which had previously been carefully calibrated by comparison with a thermometer; a complete diagram of the connections for the test is given, as also one set of hysteresis curves for different temperatures and several series of data (as the weight or volume of the iron does not appear to be given, the results are only of value relatively). For annealed charcoal iron wire some of the results were as follows: At 20 degrees C. the loss was 2,350 ergs per cycle, at

290 degrees it was 1,600, and at 836 degrees, 316 ergs; for Swedish iron the results for 20, 270 and 812 degrees were 2,690, 2,080 and 712 ergs; at about 744 degrees the results were irregular. For soft wrought iron he found the law was as follows: $L = a - b\,t$, in which L is the loss in ergs per cycle, t the temperature in centigrade degrees, and a and b constants for the material, which, however, depend on the maximum induction, which in this case was 3,590; for steel this law did not apply, as the rate of variation changed. He found, furthermore, that for greater inductions than the one given above, the straight line law in the case of soft iron expresses the relation with sufficient accuracy. For steel, it was found that there was a bend in the curve at about 300 degrees C., from where, up to 600 degrees, it approached that for soft iron. A series of experiments was made, in which these tests were repeated with the same iron, and it was found that for soft wrought iron there was a continual regular decrease in the hysteresis loss in each cycle (corresponding to the same temperature) up to the fourth, after which no further change could be noticed; for "patenttiegelgussstahldraht" (meaning a patented crucible steel wire) it was found that the hysteresis loss diminished in each of the corresponding cycles up to about the fifth, after which no further change could be noticed; the relation of the loss in the fifth cycle, as compared with that in the first, was as 1 to 8.3; the curve for the hysteresis as a function of the temperature had the broken characteristics of steel curves for the first cycle, but for the second and subsequent cycles it approached the curve for soft iron; this shows that after several cycles the steel takes the properties of soft iron, as far as temperature and hysteresis are concerned (it appears that the single cycle was taken at each value of the increasing temperatures, the series being repeated after the iron had gotten cold again, as distinguished from a repetition of the same cycle at each temperature). In another experiment with soft iron the first cycle was taken at the normal temperature, the second at the highest temperature, 750 degrees, and the third at normal temperature again; the area of the hysteresis curve in the second test was only one-quarter that at normal temperature, while that in the third test was two-thirds of that of the first. Some figures are also given for nickel, the curve for which is a broken line. In conclusion, he states that by means of repeated cycles, while the iron is hot, the hysteresis loss for the iron when cold may be greatly reduced; he also believes that the same can be accomplished with a single cycle at a very high temperature.

Magnetism of the Planets.—"La Lum. Elec.," March 31, contains a note showing that Mr. Leyst, of a Russian observatory, claims to prove scientifically that the other planets possess magnetism like the earth.

Magnetic Screening.—Mr. Foeppl, in the "Elek. Zeit.," April 12, suggests that in recently published articles it does not appear to have been noticed that hard iron will make a much better magnetic screen than soft iron for screening delicate magnetic instruments from magnetism, citing as an illustration that magnetic flux cannot be made to penetrate to the interior of a large steel magnet.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Transparent Conducting Screens for Measuring Instruments.—In an Institution paper by Prof. Ayrton and Mr. Mather, reprinted in the Lond. "Elec. Eng.," April 13, they describe a varnish for coating the glass of electrostatic instruments, which varnish conducts sufficiently well to screen the needle from electrification from the outside, such as that due to rubbing off the glass. After describing a number of different unsuccessful attempts, they give the following receipts, which are claimed to give perfectly satisfactory results; it is somewhat difficult to apply the coating so that it is neither cloudy nor a comparatively poor electrostatic screen. No. 1. "Dissolve one-fourth ounce of transparent gelatine in one ounce of glacial acetic acid by heating them together in a water bath at 100 deprees C. To this solution add half the volume of dilute sulphuric acid, which has been prepared by mixing one part of strong acid with eight of distilled water by volume, and apply the mixture while still warm to the glass shade, which should be previously polished and be warm. When this film has become very nearly hard, apply over it a coating of Griffith's anti-sulphuric enamel." Method No. 2. "Thin the gelatine solution, prepared in the manner previously described, by the addition of acetic acid (say two volumes of acid to one of solution), and after polishing the glass, float this thin solution over the glass cold. Drive off the excess af acetic acid by warming, allow the glass to cool, and repeat the floating process, say, twice. Thin the anti-sulphuric enamel by the addition of ether, and float it over the gelatine layer applied as just described. Expel the ether by heating, and apply a second layer of this thinned anti-sulphuric enamel."

The Lond. "Elec.," April 20, criticises this paper editorially and intimates that the effect of the electrostatic charge of instruments in stations has been exaggerated, being by no means a serious matter. The same issue contains a communication by Prof. Ayrton, in which he gives the results of experience with the electrostatic effect on the needle of station instruments, showing what a great error can be produced by slightly rubbing the glass; he also calls attention to the fact that the error is an unknown quantity, therefore making the readings uncertain; he also shows that the idea that a layer of oil prevents the glass from being electrified when rubbed is a common mistake (presumably he refers to a certain class of instruments not described, as the effect is undoubtedly different with different instruments).

Universal Shunt Box.—In an addition to the discussion of the recent paper on this subject published in the Lond. "Elec.," April 20, Prof. Ayrton gives some numerical examples to compare his method with the ordinary one, showing the advantages of the former, especially in connection with the discharge of condensers, in which case the controlling magnet in the ordinary galvanometer requires different correction to be made every time it is moved; the paper is discussed editorially, and while some of the claims are admitted as beyond dispute, the claim that the resistance of the circuit is less altered cannot be maintained, as the change is sometimes greater and sometimes less; the increase of resistance by using the shunt may be many times that of the galvanometer.

Astatic Station Voltmeter.—The paper of Prof. Ayrton and Mr. Mather, abstracted in the Digest last week, is published, together with the illustrations, in the Lond. "Elec. Rev.," April 20. (We call attention to the fact that the "full-sized" cut showing the scale has been reduced by about one inch, although no mention is made of it in that reprint, where it is spoken of as full-sized.)

Modified Lippmann Electrometer.—The Limb modification is illustrated in "La Lum. Elec.," April 7, the object being to adjust the level of the mercury to any desired point, which is accomplished by connecting a vessel of mercury with the tube by means of a flexible connection and raising or lowering this vessel.

Photometry.—Captain Abney's second lecture is abstracted in the Lond. "Elec. Rev.," April 13, but gives little or nothing that is new; in his opinion the Rumford method, popularly called a comparison of shadows, is as accurate, if not more so, than the Bunsen method, in which the grease spot is used; regarding the latter, he says that it is very important that the disc should be clean and perfectly free from scratchings; the Harcourt modification of the Rumford method is described, though not very clearly; he claims that errors can arise when using an illuminated opening in front of a light as a standard, as in the Methven screen; it is often

stated that the eye could appreciate one-sixtieth part of light, but this figure, he says, is not a constant, depending on the illumination; with the best light, for instance, one two-hundredth could be distinguished; he thinks that the oscillation principle is a good one in photometry, as the eye does not become so fatigued. It is quite illusory to speak of a fixed degree of accuracy of a photometer, for with a feeble light a difference of 2 per cent. is not appreciable, but with strong lights 1-2 per cent. or less can be detected.

In his third lecture, abstracted in the Lond. "Elec. Rev.," April 20, he stated that the law of inverse squares, although true in reality, was not true to the eye, because the eye had a limit; with red, green and blue lights thrown on screens it was found on cutting down the luminosity of each equally that red disappeared considerably before the green, the law of inverse squares was therefore not true when dealing with faint lights. A one-candle ether-Argand is described; air is passed over ether, forming a combustible gas, which is burned in a very small Argand burner, the top of the flame being cut off by a screen, the portion of the flame below the screen yielding a constant light, even though the height of the flame may be varied considerably; in a 10-candle pentane-Argand standard the height of the flame was varied as much as 2 inches without affecting the intensity of the light below the screen.

Photometer.—The modified Foucault photometer is described and illustrated in "La Lum. Elec.," April 7; it is a photometer for contrasting two surfaces without the employment of prisms like those in the Lummel & Brodhun.

Carcel.—According to "La Lum. Elec.," April 7, determinations of the equivalent of the carcel by different authors are as follows: Schilling, 9.6 English candles or 9.826 German candles; Le Blanc, 9.30 English candles; Monnier, 8.3 English candles or 7.5 normal German candles; Violle, 8.91 English, 7.89 German candles, 9.62 bougies decimales, 9.08 Heffner standard or 0.48 Violle units.

Measuring the Magnetic Qualities of Iron.—In a paper reprinted in the "Elek. Zeit.," April 12, Dr. Koepsel describes in detail, with the aid of a large number of curves, an instrument made by Siemens & Halske and devised by himself for making such determinations in absolute measurements by direct reading. The instrument is identical with that shown by Mr. Robinson in The Electrical World Feb. 24, page 236, but Dr. Koepsel claims to have invented it long ago.

Measuring the Difference of Phase.—In "La Lum. Elec.," March 17, Mr. Hess describes the principle of various forms of apparatus, including the theory of one of his own, for measuring the difference of phase between two currents; most of the forms have been described before.

Measurement of the Resistance of Earth Contacts.—The "Zeit. fuer Elek.," April 1, contains an article by Dr. Hiecke, in which he discusses mathematically the measurement of such resistance by means of potentials.

Cadmium Standard Cell.—The E. M. Fs. of the Muirhead & Deerlove cells for percentages of cadmium are given in "La Lum. Elec.," April 7; an amalgam of one of cadmium with seven of mercury, giving an E. M. F. of 1.0192, is preferred.

Clark Standard Cell.—A paper by Mr. Kahle is abstracted in the Lond. "Elec. Rev.," April 20; he criticises severely the Board of Trade standard and urges its replacement by the H form of cell.

Symbols.—The "Rev. de l'Electricite," March 31, reprints from a French physical journal a set of abbreviations for all the units of measurement of the metric and electric systems, by Mr. Guillaume, consisting chiefly in the use of the initial letter of the unit preceded by the letters *M*, *k*, *m* and μ for the prefixes mega, kilo, milli and micro respectively.

Electrostatic and Electromagnetic Dimensions.—"La Lum Elec.," March 17, reprints from "Nature" a reply of Mr. Ruecker to an article by Mr. Mercadier on the relative values of the two systems.

Mirror Galvanometer.—In the "Elek. Zeit.," April 12, a description is given of a new galvanometer of Siemens & Halske with liquid damping.

Meter.—The Dejardin meter is illustrated and very briefly described in "L'Ind. Elec.," April 7; it appears to be quite complicated.

Meter.—The latest form of the Meylan-Rechniewski meter, mentioned in the Digest, Nov. 11, 1893, under the heading of the Eclair meter, is described and illustrated in "L'Ind. Elec.," April 10.

Influence Machine.—The improved machine of Mr. Bonetti, mentioned quite frequently in the foreign journals lately, is described in "L'Ind. Elec.," April 10.

Radient Heat.—An article by Mr. Kurlbaum on a method for the quantitive determination, is abstracted in "La Lum. Elec.," March 17.

Demonstration Apparatus.—The lecture apparatus of Mr. Grimsehl to demonstrate the laws of electromagnetic induction, is fully illustrated in "L'Elec.," April 7.

Discharge Key.—An improved form of the Sabine key is briefly described in "L'Ind. Elec.," April 10.

DYNAMOS AND MOTORS.

Designing Dynamo Magnets.—In an interesting article by Mr. Marcher in the "Elek. Zeit.," April 5, he discusses in a practical manner several disputed questions; one is the statement that the outside or longer windings have the same action as the shorter inner ones; this statement, so often made, is true only for a magnetic circuit of given dimensions; if in a new construction of the magnetic circuit the lengths of the windings are shortened there will be more lines of force for the same amount of copper; he describes an experiment in which two magnet frames were wound so as to fill the whole coil space, in one case with a 2-millimetre wire and in the other with a 0.8-millimetre wire, the number of windings and the current being the same in both, and consequently the magnetic circuit was larger in the first case; the number of lines in the two cases were as 1 to 1.44; the outside diameters of the coils were 41 and 30 millimetres, showing that the lines of force increased in a greater proportion than the lengths of the windings decreased, which is explained by the fact that the leakage is greater; the consumption of energy was, of course, much greater for the smaller wire, being in the proportion of 1 to 4.45; that the larger number of lines were not due to a greater amount of energy was shown by winding the fine wire on the large coil magnet with layers of insulating material, so as to make the size of the coil and the length of wire the same, in which case the same number of lines were generated. The second point had reference to short and long cores with the same volume of winding; the mean length of the magnetic circuit was about the same in both, but the mean length of the windings was about as 1 to 1.36, therefore requiring more copper in that proportion; the result of this test showed that the core should be as close as possible to the return magnetic path (including the armature) as is possible without increasing the leakage too much and that the space between them should be fully filled with the windings; from this the length of the core will be given. The third point had reference to hollow magnets; he shows by means of a very rational set of experiments, that the statements which have been made to the effect that hollow magnets are better than solid ones are entirely wrong and misleading when applied to dynamo construction; these tests are fully described and illustrated and would seem to settle this question beyond dispute in favor of solid magnet cores, the conclusion being that the smallest amount of wire will be required when solid, round,

massive cores are used. A rather odd shaped ironclad dynamo, constructed according to the above principles, is shown in the article.

Alternating Current Motor.—The results of the test of the Joel motor (described in the Digest July 1, 1893) are given in the Lond. "Elec. Eng.," April 20; it yielded somewhat less than 1-2 per cent. with an efficiency of about 35 to 40 per cent.; the starting torque with the armature at rest as compared with that when running was about as 4 to 2.3.

Substitute for Brushes.—The Roberts collector is described and illustrated in "La Lum. Elec.," March 31; in place of commutator brushes, two flexible metallic belts or cords, guided by pulleys so as to touch the commutator only in a few sections, are used to replace the brushes.

ARC AND INCANDESCENT LIGHTS.

Lamp Filaments.—According to "La Lum. Elec.," April 7, the oxides of the rare earths utilized in the Auer incandescent gas burner, may be incorporated in the filaments by immersion for 48 hours in a warm solution of 20 parts of nitrate of magnesium, 10 zircon, 10 oxide of lanthenum and 50 of water; if treated before carbonization they should be treated again afterward; the object is to increase the light and the life.

Gas vs. Electric Lights.—According to the "Zeit. fuer Elek.," April 1, the relative costs are as follows: In Berlin 1.25 to 1, Hanover 1.46 to 1 and Cologne 1.88 to 1 (presumably incandescent lights are referred to).

Small Current Arc Lamp.—The Buchet lamp for 2 to 4 amperes, is described and illustrated in "L'Ind. Elec.," April 10; it is very highly spoken of.

Cance Lamp.—The new type of this lamp, which is largely used in France, is described and illustrated in "L'Elec.," April 14.

Alternating Current Arc Lamps in Parallel.—In Mr. Carter's serial in the Lond. "Elec. Rev." on arc lighting, he discusses this subject.

Workshop Lighting.—According to a description in the Lond. "Elec. Rev.," April 20, a large machine shop in Bolton is lighted successfully with the inverted arc lamp, the light being reflected by a white enamelled reflector.

ELECTRIC RAILWAYS.

Underground Sectional Railway System.—The Rast system is described in the "Elek. Anz.," April 8; it is claimed to be no more expensive than the usual overhead arrangement and is spoken of very highly by a well known German expert; there is no conduit, the current being taken from insulated sections on the surface which are connected to the line when the car passes over them, by means of a magnet on the car and a switch operated by the same, inclosed in underground boxes.

Underground Line in Berlin.—According to the "Elek Tech.," March 15, a concession has at last been granted for the first part of a system of electric underground lines in that city.

Paris Accumulator Lines.—In a lecture by Mr. Deri, reprinted in the "Elek. Tech.," March 31, he gives some data regarding these lines.

Electric Traction in England.—The Lond. "Elec. Ind.," April 1, contains the first part of an article by Mr. Wilkinson, in which he deals with the past of electric traction and its future in England; frequent references and comparisons are made with this industry in the United States.

Electric Vehicle.—The conditions for the prize competition offered by a French daily journal for small vehicles containing their own propelling power are published in "La Lum. Elec.," March 31.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Rotary Field Installation.—According to Mr. Dahlander, in an article in the "Elek. Zeit.," April 5, the late Mr. Wenstroem was an independent inventor of the rotary field; the company in Sweden operating his inventions has been building such motors since 1890. Their first installation, which is described and illustrated in that article, has lately been completed; a water power is transmitted to the villages of Hellsjoen and Graengesberg in Sweden. A short abstract of this article is given in the Lond. "Elec. Eng.," April 13.

Rotary Field Currents.—In his serial in the "Elek. Anz.," March 29, on a universal physical fundamental law, Mr. Schwartze discusses the subject of the rotary field currents and shows mathematically that it is absurd to talk of a saving of 25 per cent. in the line wire when the system requires 30 per cent. more coal.

The Central Station Question in France.—In an article in "La Lum. Elec.," April 14, Mr. Claude discusses the causes of the somewhat unsatisfactory condition of the central stations (presumably in France), and suggests remedies.

Country House Electric Lighting.—In a paper by Mr. Acourt reprinted in full in the Lond. "Elec. Rev.," April 13, he discusses the various sources of power, the apparatus and the estimated costs for private plants in mansions outside of the cities.

Three-wire System with a Single Dynamo.—The system described and illustrated in the Digest Feb. 3, is described more in detail, together with some calculations and a number of illustrations, in "L'Elec.," April 7. An abstract is published also in the Lond. "Elec. Eng.," April 13.

Best Frequency.—An abstract of a translation of the article by Mr. Kolben (see Digest, March 10), together with the curves, is given in the Lond. "Elec. Rev.," April 20.

Cost of Energy in Stations.—The Lond. "Elec. Rev.," April 20, publishes a translation, including a large table, of the data regarding six large stations in Germany, mentioned in the Digest Jan. 27.

Interrupters.—In "L'Elec.," March 31, Mr. Leroy calls attention to the difficulties in making a minimum current interrupter (such as is used for accumulators, for instance), and describes a means of overcoming the difficulty by the automatic insertion of shunts, the apparatus being thereby made much more sensitive and sure; a diagrammatic illustration accompanies the article.

Windlass for Suspended Arc Lamp.—A novel form is described and illustrated in "L'Elec.," April 14; it can be turned only one way by means of a removable crank and cannot be lowered by any one except with this crank; to lower it a friction brake is released by means of the same crank.

Elevator.—The Tylan elevator is described briefly in "L'Elec.," March 31; it provides for starting and stopping the machinery gradually.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Best Resistance for Receiver on Leaky Telegraph Lines.—In the Lond. "Elec.," April 20, Dr. Sumpner gives a simple proof of the statement made by Prof. Ayrton and Mr. Whitehead in their recent paper (see Digest April 28); it is also discussed editorially. In commenting on this paper editorially the Lond. "Elec. Rev.," April 20, calls attention to what it terms a great omission in not pointing out that while that resistance may be the best to give to an instrument, it ought also to have been stated that a very considerable departure from that value could be made without any material effect being produced upon the efficiency of the apparatus; as an example is cited the well known law about the maximum sensitiveness of a galvanometer being arrived at when its resistance is equal to that of the external circuit, and that it has been shown that this maximum law may be very largely departed from without very greatly affecting the sensitiveness of the instrument.

Telephone Meters.—In "La Lum. Elec.," March 31, Mr. Hess discussses the subject and describes several meters for different purposes.

Rewinding Mechanism.—The system of Denezet for electrically rewinding telegraphic mechanism requiring mo-

tive power in the form of a weight, is described in "La Lum. Elec.," April 7.

Submarine Cables.—An article on the Pacific cable is contained in the Lond. "Elec. Rev." and "Elec. Eng.," April 20. The Lond. "Elec.," April 20, gives some data regarding the new Atlantic cables to be laid this year. The Lond. "Elec.," April 20, gives a short account of the cable steamer Duplex.

Block System.—The Fletcher system is described and illustrated in "La Lum. Elec.," March 31.

Clocks.—A new contact device for standard clocks is described and illustrated in the "Elek. Anz.," March 15.

ELECTRO-CHEMISTRY.

Accumulators.—The Roe & Surtro accumulator is described and illustrated in "La Lum. Elec.," March 17. The Petschel accumulator is described and illustrated in "La Lum. Elec.," April 7.

A New Depolarizer.—The "Elek. Tech.," March 31, mentions but does not give the composition of a new depolarizer of Dr. Oppermann; it is said to give double the current strength of a Bunsen cell at 1.9 volts, it gives off no fumes, and has less powerful action on the materials than nitric acid has; the consumption of zinc is said to be very much reduced; as exciting liquid he uses a concentrated solution of kitchen salt in place of the sulphuric acid; the cost of his depolarizer is not more than that of strong nitric acid, although it is said to have three times the output.

Lighting from Primary Batteries.—A system in which primary batteries are used to charge accumulators is described in "La Lum. Elec.," April 7.

Electrolysis on Organic Substances.—The Lond. "Elec. Rev.," April 20, summarizes some recent work in this branch, among which are the reduction of nitro-benzine, for which it gives the formula; the production of aniline, the oxidation of glycerine and the reduction of aromatic nitro-compounds.

Electrolyzer.—The Blockmore and the Cutin apparatus are described and illustrated in "La Lum. Elec.," March 17.

Aluminium.—The serial of Mr. Richard, in which a number of furnaces are described and illustrated, is continued in "La Lum. Elec.," April 7.

Elmore Process.—The "Elek. Anz.," April 5, reprints a lecture by Dr. Feldmann on this method of copper deposition.

Chlorate of Potash.—In Savoy, France, an installation is being erected for the electrolytic production of chlorate of potassium.

Velocity of Ions.—The Lond. "Elec. Rev.," April 20, abstracts briefly a paper on this subject.

MISCELLANEOUS.

Cooking.—According to a note in the Lond. "Elec.," April 20, Mr. Crompton claimed that the English were far ahead of the Americans in electric cooking apparatus. He uses three kinds of enamel, the hardest is first laid on the plate, the conducting wire is then spread upon it, a second coat a little less hard is laid over it, and, finally, a coat of white enamel is spread over all; he uses nickel-steel wire in place of copper or other metal; he claims that his success is due to a method for crimping and laying the fine wire by machinery on to a dummy plate and then transferring it bodily to the enamel.

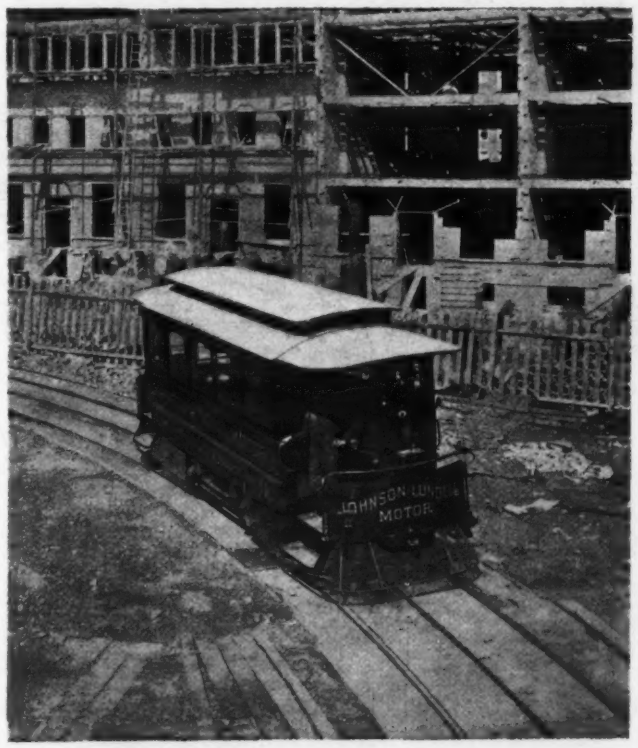
Welding.—In an installation at Bolton, mentioned in the Lond. "Elec. Rev.," April 20, a current of about 25,000 amperes at about two volts is required to weld a shaft 2 1-8 inches in diameter, representing 67 h. p. for two minutes.

Electricity in the Navy.—It is reported that every gun on future warships of the English Navy will be equipped with electrical appliances.

The Johnson-Lundell Electric Railway System.

For some time it has been known among electrical engineers that a novel system of electric railway traction was under experiment on a track installed on private grounds in the upper part of New York City. Considerable curiosity has been manifested as to the details, particularly as it was reported that the practical tests carried out on the experimental road have given results entirely satisfactory to those pecuniarily interested. The system is the invention of Messrs. E. H. Johnson and Robert Lundell, the former so well known as one of the pioneers in the introduction of the electric light, the trolley railway and the interior conduit system of wiring, while the name of the latter is familiar in connection with the Lundell dynamos and motors, which have been so favorably received by the engineering profession.

The track of the experimental road referred to runs around a whole city block, with stiffish grades and with difficult curves of necessarily short radius. The power house is at the foot of the hill and at the centre of that section of the track or circuit. The generating plant comprises a vertical engine driving directly a pair of Lundell dynamos, the unit being such that it could be enlarged on exactly the same proportions up to any size for any road. By means of the interior conduit telescopic iron tube, current is carried to the



CAR AND TRACK OF JOHNSON-LUNDELL SYSTEM.

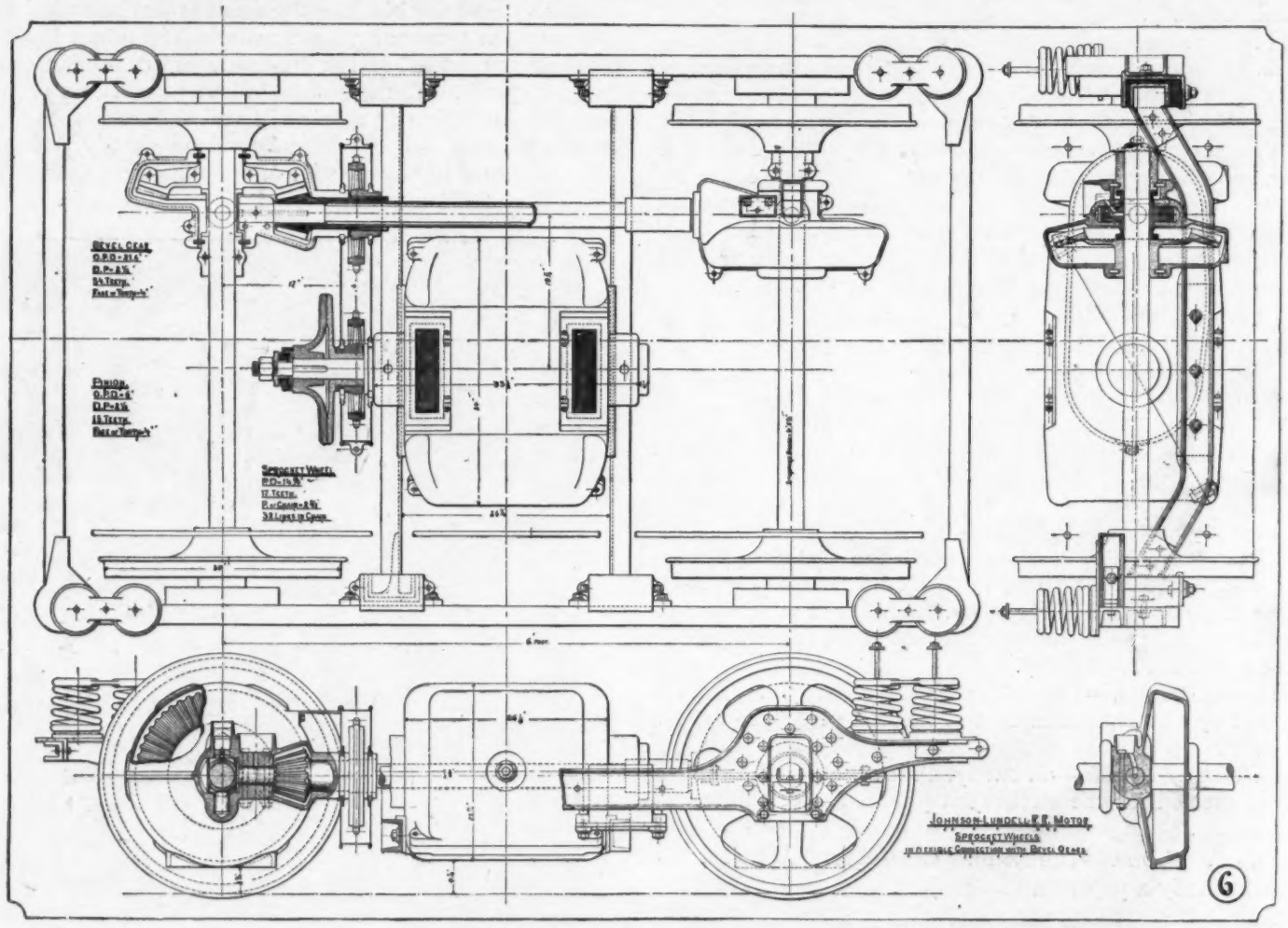
track at the proper points of feeding, and is distributed without any loss due to leakage or conduction, owing to the high insulation of the ducts. The track itself is of ordinary construction as to the rails. Between the rails it is asphalted or paved and parallel with the rails lies a conducting bar or strip of metal embedded in the asphalt. This bar is level with the surface, and is divided up into sections with insulating blocks of stone or other material between them. Just outside the single track, or midway between the double tracks, are plain, watertight boxes with iron covers flush with the street surface. In these boxes are substantial electromagnetic devices which deliver current to the section of the track it governs, as the car comes along, and then lie quiet until the succeeding car rolls up. The car carries a pick-up rubbing brush, which leads the current into the motor and takes the place, or fulfills the function, of the trolley pole wheel. The road is not alive anywhere except

at the point over which the car is passing. Moreover, the difference of potential between the two sides of the circuit between which the car moves is practically and actually nil; hence there is no danger to horse or passer-by.

The car has but one motor, a feature toward which all the first-class electrical inventors have been directing their energies for years. This motor is central under the car and drives on each axle by means of bevel gear, and with sprocket wheels and link chain in flexible connection with the same. Its suspension is flexible, the bevels are boxed, the sprocket wheels and links mesh noiselessly; and by means of a bipartite screw coil in close relation to the armature shaft, the motor, though capable of instantaneous arrest or sudden starting, never moves off or stops with a jerk. It sustains no jar, no sudden rush of current, no heavy short circuiting, no swift reversing and consequent breakdown. The spring coils are an efficient buffer between it and any danger. The motor is, moreover, iron-cased and protected against dirt, stones, moisture, etc.

Underneath the car is a steel brush which gathers up the current and passes it up into the motor, the return being as usual through the rails, which are obviously harmless, as the conducting strip between them is only alive when a car is right over it. But the car is not dependent merely upon the supply of live current. Under the seats are frames holding a very simple elementary form of lead storage battery, enough to furnish the voltage at which the motor runs—300 volts—and though with very few plates in each cell, giving considerable capacity, which can be called upon to carry the car through emergencies. The batteries perform several functions; the battery "picks up the circuit" for an instant when starting, lights the car, and, above all, renders it at once self-contained and dispenses with the usual costly, complicated and troublesome wiring at crossings, switches, steam railway tracks, etc. If the car has not sufficient headway to run over a crossing, the battery will do that, just as it will keep the car going should it be deprived of central station current or even put on a line that is without electricity.

One of the claims for the system is the absolute and immediate control of the car which it gives. The apparatus is so combined that when the motorman wants to use his brake, the propelling power at once becomes his ally. To-day, on the ordinary trolley car, no motorman dare reverse his car, because if he does he will have neither motor nor position left. What is needed is that the motor shall first stop, and then reverse its direction of rotation while the car may be traveling onward. To do this there must be an interval of free elasticity, however brief, so that while there is a sequence of effect it is so gradual that nobody could tell



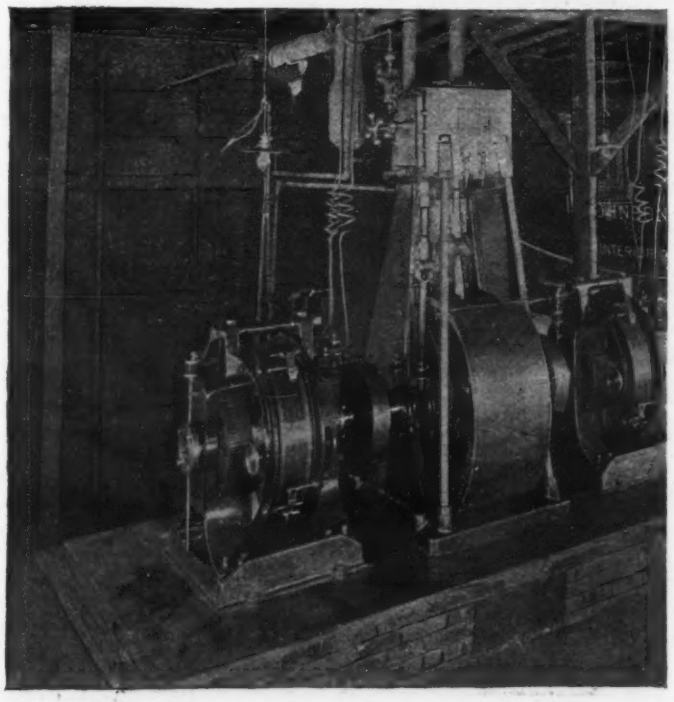
PLAN AND ELEVATION OF MOTOR TRUCK.

when the moment of reversal began and nobody would know that the car had smoothly followed suit until it had come to a halt or gone backward. This is done in the Johnson-Lundell system, not by any auxiliary apparatus, but by the motor itself, so that all the motorman has to do is to pay attention to the one handle of the switch stand in front of him on the platform. At sight of anybody on the track before him, the driver turns the crank handle, when the motive power at once begins to head the car the other way—although its momentum may apparently be urging it onward. Such a form of equipment is superior, in securing safety for the public, to any brake or car fender that could possibly be imagined.

As to the first cost it is claimed that the Johnson-Lundell system compares more than favorably with anything that has gone before. To install it well involves a liberal expendi-

tu.e, but the outlay is small compared to that for the cable system, and on practically equal terms with that of a well built trolley road. There is no deep excavation, there are no poles to set, no overhead wires to maintain, no trolley poles and wheels to renew. The conducting strip along the track does not scrape away in any perceptible degree, and the steel brush will perhaps wear to a stub after a great many months' use. The magnet boxes have nothing to wear out except strong little contact jaws, and the iron tubes are a solid protection to the feeders. On the cars the gears are liable only to the usual wear, and to less than that, as the elastic connection prevents any grinding or stripping action. The battery is under the most favorable conditions that could well be conceived. It gets no strain, and little work, but when the opportunity presents itself, it is always fresh and ready. Besides, the use of but a few plates in the batteries on these cars greatly simplifies the conditions of their care. Another feature is that each car has its single set of batteries and does not have two or three other relay sets lying around a large central power house to be charged, occupying time and space and attention. What charging these batteries get is given on the road while the car is at work.

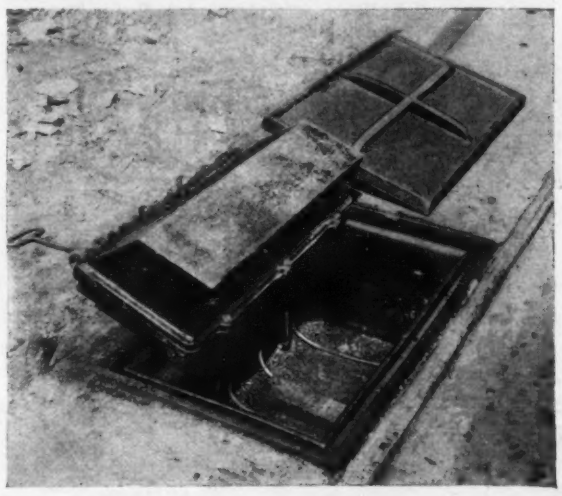
The rapid depreciation of cables and grips in the cable system, and of poles and overhead wiring in the trolley system, is a fact very familiar to all street railway men. In the trolley system, the item of depreciation has been very often abnormally large on account of the racking of the motors and their burning out. The line renewal, however, in the Johnson-Lundell system becomes, it is claimed, as insignificant as it does in underground conduits generally, where today the rental and not the renewal is the only item that is thought of. As for the motors, they are no longer subject to rapid depreciation, having between them and the evils they have been liable to a method of resilient gearing that



GENERATING PLANT.

cushions them against any abrupt action or onslaught, and whose presence at once absolves from the readjustment of mechanical parts the use of levers, the renewal of brake shoes, etc. The central conducting rail or strip should undoubtedly have a very long life. It is by no means as liable to the hammering of traffic as a cable slot, for the reason that being a thin edge, so to speak, no horse or wheel is likely to occupy itself long in the effort to balance upon it.

The independence of weather considerations of this system was illustrated by its trial during the past winter. The winter was a wet one with rapid fluctuations. Mere snow or ice in cold weather is little test of a system, as dry snow and ice are good insulators and are easy also to clean out of



SWITCHBOX IN POSITION FOR INSPECTION.

the way. But wet snow and soft ice, such as the last winter saw so frequently, are the bugbear of the electrician. Yet the Johnson-Lundell car ran through it all, day in and day out, and apparently the better when the days were wettest. All the track views here shown have been made from photographs taken in winter time; yet, as will be seen, the car ran through thick snow, the switch boxes were opened up and exposed, and all manner of severe tests made with the utmost ease and success. If the car went on running for years the demonstration of practicability could not be more effective or conclusive.

It is claimed that the cost of operation is moderate. The storage batteries are reduced to their simplest form, given their lightest work and put where the least attention is required. No construction or repair gangs are needed to patrol and repair an overhead line, and the single motor reduces this item of expense. Another point is that the motor starts the car with but a normal supply of current, and hence its power and weight, as well as the generating plant and attendance, are less. It is claimed that the special winding of the motor under this car gives it all the flexibility of two motors, as its coils when thrown into series and into parallel by means of a new form of series parallel controller accomplish all that has been aimed at in that device through its various modifications, although it is only now that the drawbacks are avoided of having to consider and deal with two mechanisms. It is obviously also more economical to vary the conditions of speed and current in one motor than in two. In the Johnson-Lundell system of car control, all the mechanisms and operations have centred in the one handle. Hence the strain on the nerve and intelligence of the motorman is less, with less liability to accident.

Other advantages enumerated for the system are that as every car has a reserve of power each becomes an independent unit, thus securing a gain in flexibility, freedom from blockade, etc., unlike a trolley car when cut off from its supply; the motor is a very quiet one and the pick-up brush and magnets in the switch boxes give forth no audible noise; the only evidence on the street that the system is an electric one is the little strip central between the ordinary car rails. Other points of superiority over the trolley and over other conduit systems are claimed, and supported by very thorough tests under the most unfavorable conditions during the past winter.

Street Railway Fittings.

We illustrate herewith some of the street railway line fittings manufactured by the Ohio Brass Company, Mansfield, Ohio, whose use will be apparent, as well as their efficient design. This company is noted for the character of

STREET RAILWAY FITTINGS.

its fittings, not only as to material, but also as to design, and it manufactures an unusually complete line, including numerous forms of trolley hangers, switches, and cross-overs.

A New Arc Light Dynamo.

Arc lighting machinery has not received of late years the attention it formerly did, owing, no doubt, to the great developments in other branches of electricity; but more recently renewed interest in the subject seems to have been awakened, and we illustrate herewith a new constant current arc light dynamo and regulator, the invention of Mr. Foree Bain, and manufactured by the Great Western Manufacturing Company, Chicago.

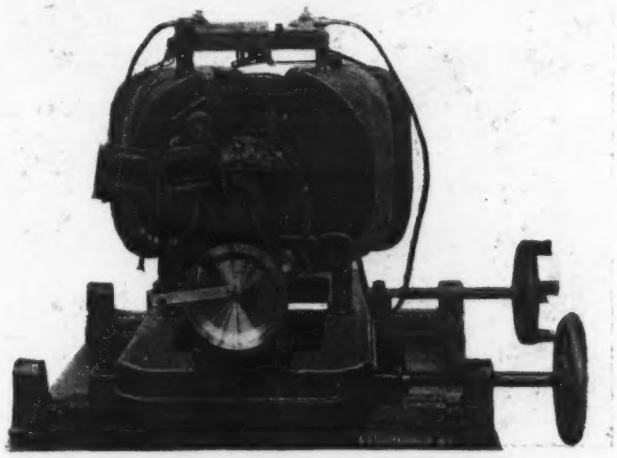
The regulator is said to be sensitive and at the same time positive in operation, and will maintain a constant current independent of the number of lamps in circuit. The machine may be run indefinitely on an absolute short circuit without injurious results. The field is of the salient pole, horseshoe type, cast in one piece. The armature is large in diameter and strongly built; it is of the Gramme type having independent coils, and a large number of them, by means of which a very steady current is produced. The brushes, or collectors, are made of carbon and are so placed as to produce a constant lap on the commutator.

The automatic regulation is performed by the movement of the brushes around the commutator. The motor device, to accomplish this movement, is operated by means of a small belt connected from the armature shaft to a larger pulley, as shown in the illustration. In the rotation of this larger pulley a ratchet bar is reciprocated, the small ratchet of which is held out of engagement with the ratchet wheel by means of two elliptical springs on either side of the armature, placed between two pairs of electromagnets. The ratchet wheel is connected by means of a shaft, not shown in the engraving, to a small pinion which engages in gearing cut on the rocker arm which carries the brushes.

The directing device, shown under the connecting board, which is mounted on top of the dynamo, consists of a small iron bar suspended immediately over the armature; this director controls two contact devices, shown on the top of the connecting board, which operate to short circuit both electromagnets when the machine is working under normal conditions.

The thumb nut, on the right hand side of the engraving, and just below the connecting board, illustrates a means of adjusting the value of the current while the machine is in operation. This thumb nut is connected by means of a bar and a spiral spring to the director bar and tends to hold it in a position opposite to the position that the bar would assume by an increase of current in the armature.

The operation of the device is as follows: When the machine is first started the spring connected to the controller pulls the controller bar into a position approximately parallel with the path of the current circulating in the wires of the armature. When the current in the armature has assumed a given value, which is predetermined by the tension of the spring, the deflecting bar is deflected from a line parallel with the current in the armature to a line slightly at angle therewith; before it has been deflected, however, to the position described, the contact above the deflecting bar has been opened by the deflecting bar being out of the position it assumes when the machine is operating under normal conditions. An open contact above allows the current to pass through a pair of electromagnets, on the right hand side of the armature, situated between the two pairs of electromagnets. The current circulating in this pair of electromagnets attracts the armature toward them and engages the ratchet device in the ratchet wheel and quickly gigs the latter, in this case, in clockwise direction, which moves the brushes to a point on the commutator corresponding to the highest potential. If the external resistance is such that the current may be maintained with a lower voltage than the maximum of the dynamo, the current tends to rise above its normal value and the director is deflected to a still greater angle, which causes the contact controlling the electromagnets on the



BAIN ARC LIGHT DYNAMO.

left hand side of the electromagnetic armature to be closed, and at the same time, or possibly a period later, the contacts controlling the electromagnets, on the left hand side of the armature, are opened, allowing the current to pass through them. They then attract the armature, which causes the double ratchet to engage in the ratchet wheel in such a way as to cause the wheel to move in an opposite direction from that just described, by means of which the brushes are

moved forward on the commutator to a point where the E. M. F. is just sufficient to maintain a constant current through the resistance contained in the circuit. When the machine is operating through a circuit which is substantially unchanged, the brushes remain quiet and the only moving device is the crank wheel and the reciprocating bar which holds the ratchet, as the ratchet is held out of engagement until one or other pair of the electromagnets are energized.

The director device may be adjusted at any time while the machine is operating so that it will maintain a constant current within a range of 20 per cent. of its rated capacity.

Cutter's Arc Insulator.

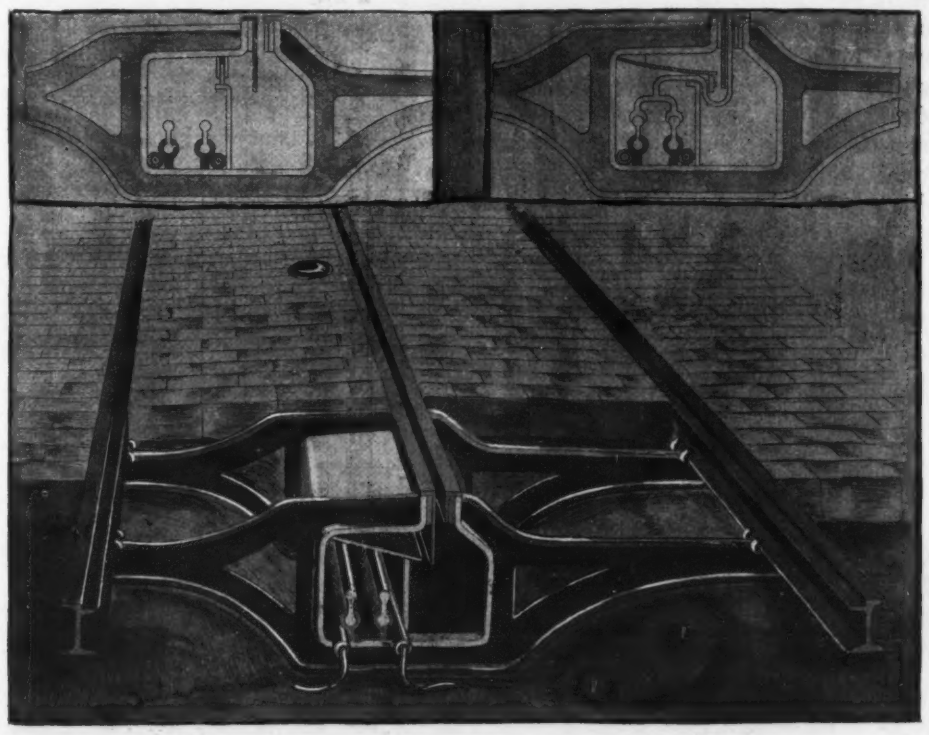
Most arc lamp users have felt the need of a good device for insulating the frame of the arc lamps from the hoisting rope or the supporting arm, so as to reduce the chances for grounds in wet weather. The arc insulators now in the market and the substitutes known as break insulators are readily covered with a film of moisture on rainy days, so that at such times they are very inefficient. George Cutter, of "The Rookery," Chicago, has devised a new form, which, it is claimed, avoids this source of trouble. Our illustration shows the new type, which is only twice the size of the cut. The insulator proper is made of hard rubber, which is less likely than glass to have a film of moisture form on its surface. The double petticoat gives a good water drip, so that the moisture cannot creep across the lower surface. All parts are planned for ample strength, the eye at the top and the snap hook at the bottom being threaded into bushings, which are moulded directly into the rubber, and the whole device seems well suited to the needs of the case.

ARC INSULATOR.

Street Railway Conduit System.

The chief objection to underground railway systems has been the leakage resulting from the accumulation of moisture and dirt in the conduit and the consequent difficulties of insulation, and this trouble has been so serious that it has prevented the introduction of conduit systems for traction work. Mr. H. Petersen, proprietor of the Petersen Electrical Works, Milwaukee, Wis., has invented a system, which, it is claimed, successfully obviates this difficulty. The chief aim of the inventor has been to guard against the effects of moisture and dirt, and it will be seen from the accompanying illustration that the principal feature of the system is its construction in two longitudinal compartments, one of which is arranged to contain the electrical conductors and the other to carry off the water. The latter conduit is connected at frequent intervals with the sewers and a steel broom attached to the car is arranged to sweep any accumulations of dirt into this compartment and deposit it in the sewer. The second compartment is out of line with the slot in the conduit, so that water cannot fall upon the conductors.

The partition between the two compartments is closed, being automatically opened by the trolley arm upon the car when it passes along. This is accomplished in the conduit shown in the lower portion of the illustration by vertical strips of metal of a suitable length joined and adapted to be raised between guides. This effectually prevents the water from entering the compartment where the conductors are placed. As the temperature is practically the same as that of the wall of the conduit, it is not thought that condensation will take place to any noticeable extent. Under very bad conditions it could easily be arranged to circulate air through this compartment, but it is not thought that this will be necessary. In the upper right-hand corner of the illustration a slightly different device for separating the two compartments is shown, consisting of a flexible cover, which normally rests on the division wall, but is raised on the roller carried by the trolley arm as the latter passes along.



PETERSEN CONDUIT.

It will be seen that iron or steel contact rails are used instead of copper wires for the conductors. These are divided into sections of 100 feet or any convenient length, and each section is tapped on to two main feeders and provided with a switch and safety cut-outs placed in manholes, so that in case of any trouble one section can be cut out without delaying traffic on the whole line. There are a number of different ways in which the contact rails can be held in position. In the illustration two brackets are supported on two yokes and held in position by insulating material. The whole compartment is finally coated with waterproof insulating paint and the main feeders are laid in pipes. The depth of the conduit is considerably less than that required for a cable road.

The trolley arm, as shown in the illustration, is provided with two contact arms, which nearly surround the upper part of the contact rail, so that they will not jump the conductor. They are also provided with a swivel arrangement to take up any unevenness in the track and springs are provided to keep them in proper contact with the conductors. The shape of the trolley arm will be seen from the illustration. From each contact shoe wire is carried through the hollow arm to the motor and at each end the arm is hermetically sealed. The motorman can, by moving a lever on his platform, lift the contact carrier out of the conduit at the manhole without delaying the car more than a few moments.

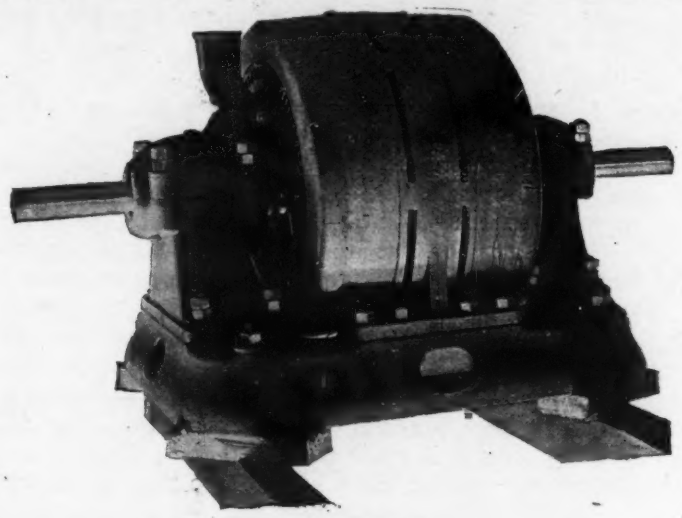
Electrical Power Transmission at Columbia, S. C.

In our last issue we referred to the important electrical transmission plant being installed for the Columbia Mills at Columbia, S. C., and illustrated the turbines. We now add some further details, including illustrations of one of the generators and one of the 65-h. p. motors.

The total amount of power to be transmitted is over 1,000 h. p., and it was decided to divide this into two units at the generating station. Consequently, two special slow-speed triphase generators were designed to meet the requirements of the case by the General Electric Company. One of these colossal machines, of 500-kw. capacity, is shown in Fig. 1. It has forty poles and operates at a normal speed of 108 revolutions per minute, giving 36 cycles upon the line, at a voltage of about 575 at the dynamo terminals.

The armature is 10 feet in diameter and is of singular and massive construction. It is of the ironclad type and is wound with a single bar per slot, heavily insulated, a construction which gives practical freedom from burn-outs and other electrical difficulties. The total weight of the machine is about 100,000 pounds.

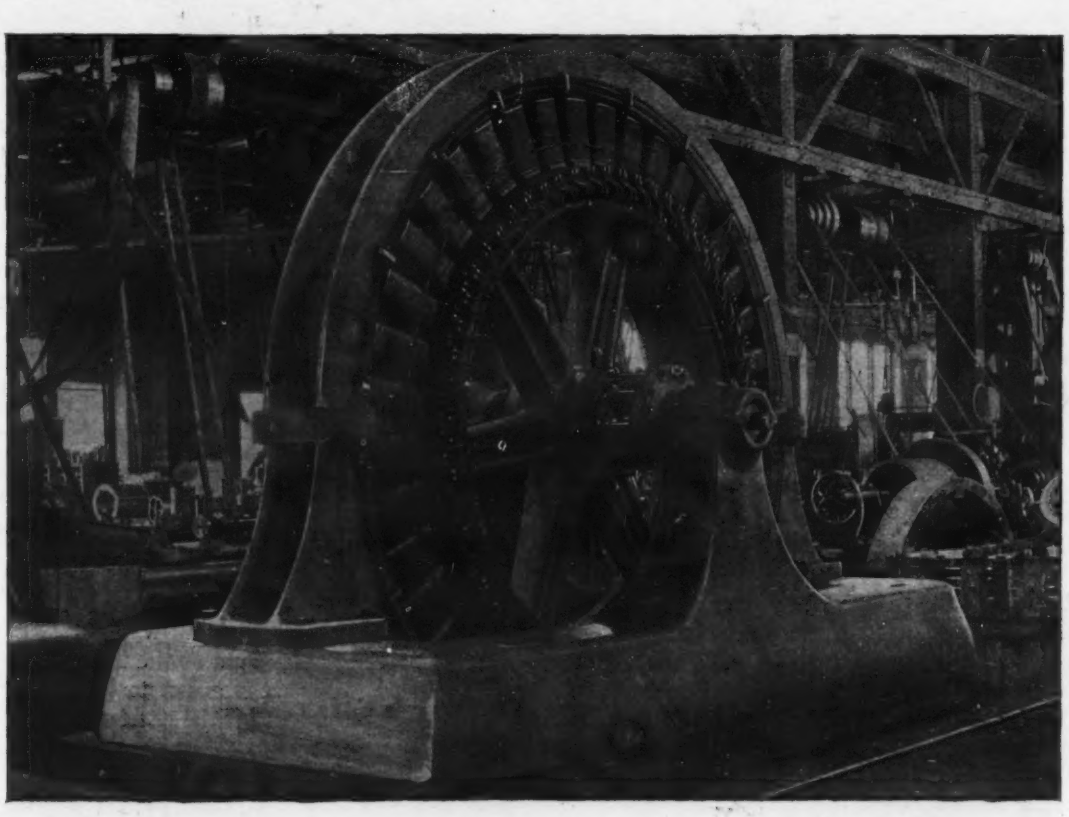
Two of these huge machines were completed in the early part of the present year and shipped to Columbia, where the turbines (shown in position in Fig. 2) were nearly ready to receive them. The transportation and erection of these huge machines were a matter of no small difficulty. A wrecking car lent by the railroad company enabled them to be unshipped from the cars, and they were then slowly moved, as one would move a house, along a somewhat circuitous route to their final position, where huge temporary shears were erected to place them upon their foundations. Fig. 3 shows one of the generators just placed in position,



65-H. P. MOTOR.

the power house proper not yet having been placed over them. The power plant consists of two pairs of 48-inch cylinder gate Victor turbines, made by the Stilwell-Bierce & Smith-Vaile Co., which are directly connected with the generators. The generating station is connected with the mill by an underground conduit of planking, protected by pitch and asphalt, the bare wires being placed in position in a bedding of asphalt. The conduit thus constructed rests on a blind drain, and is carried across the canal to the power house under a bridge, which is there erected.

In the mill there are 17 65-h. p. motors hung overhead and driving sections of line shafting with direct belting. The



500-KW. GENERATOR.

speed of the motors is 535 revolutions per minute, and varies less than 2 per cent. from full load to friction load. These machines have neither commutators nor collecting rings, and even the armature rheostat requires almost no attention, inasmuch as it is operated from the floor by means of a lever thrust into the switch socket.

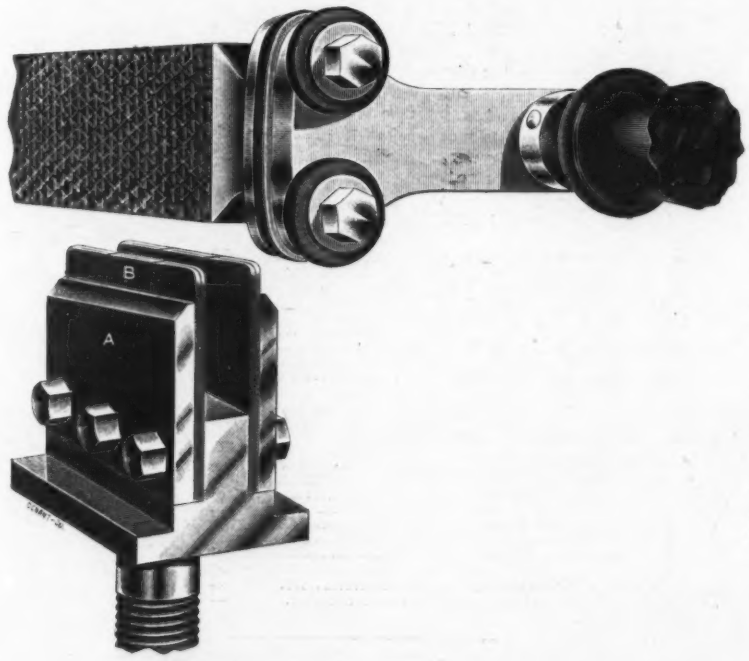
All interior wiring is in conduit tubing, and the switches are boxed in. In addition to the motors, several hundred lights are wired in the mill, and can be operated either from the main circuit or in part from either of the two 25-h. p. exciters, purposely provided with surplus capacity.

The mill is not yet all in place, but on the 24th of April the big generators were started and the motors given a preliminary spin.

An Improved Switch.

We herewith illustrate one of the latest improvements in the line of switches by the W. S. Hill Electric Company, letters patent for which have just been issued bearing the date of April 24, 1894.

The first feature in the invention is the manner in which the two or more blades are secured to the yoke so as to obtain rigidity, and keep all the blades in proper alignment while the switch is being operated. By the old method of securing the blades to the yoke (to which the handle is attached) by a single bolt or screw in each blade, there was nothing to prevent the twisting of the blades, thus allowing one to move in advance of the other, and as the two or more poles would not break in unison, excessive flashing would result. To overcome this defect and produce a more mechanical device, the outer ends of the blades and yoke have been broadened and two screws or bolts inserted, thus securing the parts so rigidly that the blades must at all times move in unison, and all the blades leave the contacts at the same instant.



A NEW SWITCH.

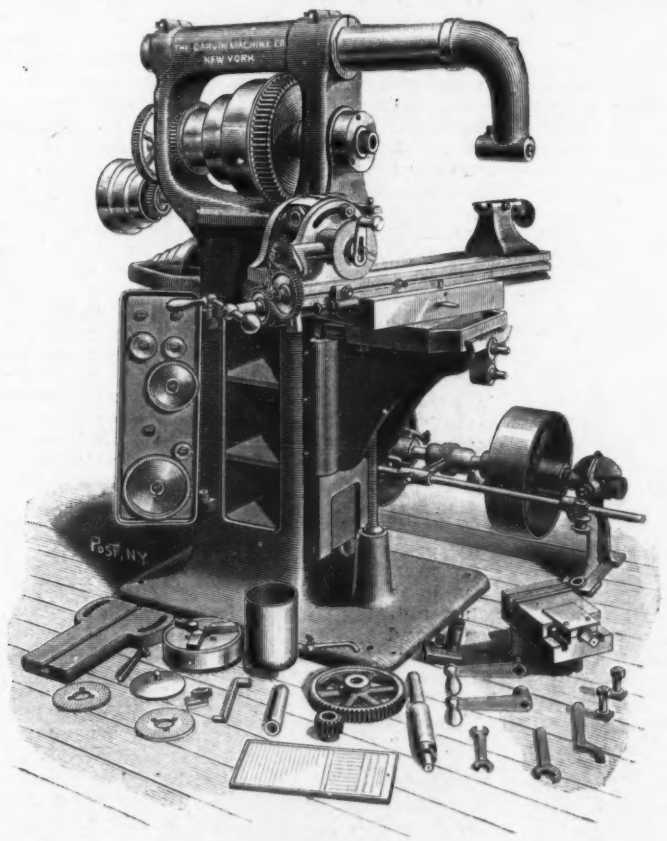
The second feature consists in backing up the regular flexible contacts, *B*, by what they term "reinforcing plates," *A*. It has heretofore been the custom to use nothing but the copper strips, *B*, and these of a necessity being flexible were liable to spring apart by constant usage, thus impairing the contact and causing the parts to heat.

By the method shown the flexibility is maintained and on account of the reinforcing plates the flexible contacts are always held in proper position, consequently the electrical connection between blade and contact is always kept perfect.

It will also be seen that the carrying capacity of the flexible copper plates, *B*, is increased by the reinforcing plate, *A*, to the maximum of any other part of the circuit, preventing loss of current in the switch and heating and destruction of its contacts.

Eight Spindle Automatic Drill.

The accompanying cut illustrates an eight spindle automatic drill press, manufactured by the Garvin Machine Company, Laight and Canal streets, New York City, adaptable to drilling or counterboring a large variety of small articles where two or more holes are desired to be drilled close together on opposite sides or ends of the piece. The spindle heads are mounted in opposite pairs on the planed surface of an inclined frame, on which they are adjustable as to their centre distances. Thus the several pairs of spindles may be set so as to drill two holes in exact line from opposite sides of the work, or parallel holes in each end of a link at one operation. The spindles have an automatic feed trip and reverse motion, and can be made to feed up to the work one at a time, in pairs, all simultaneously or in other combinations as the work may require. They are driven by pulleys, having a feather in the outer end of the bulb engaging a spline in the spindle, and running on independent hollow studs which take the belt pull, thus leaving the spindles free and sensitive. For each of the two sets of spindles on opposite sides of the machine there is an endless driving belt, passing over idler pulleys, one of which is adjustable



AUTOMATIC DRILL.

to provide for taking up the slack in the belt. The fixtures for holding the work are mounted between the spindle heads on a rail, beneath which is a cast iron trough for conducting the oil and chips to a tank beneath the machine, where the oil is strained and returned to the drills by an automatic pump. The weight of the machine complete is about 850 lbs., and with 3-16-inch drills it will produce about 5,000 pieces per day, only requiring the attention of a boy to drop in and remove the work and throw the starting lever.

Financial Intelligence.

The Electrical Stock Market.

NEW YORK, May 7, 1894.

ELECTRICAL STOCKS, in a market in which the greater part of the trading fraternity's attention has been bestowed upon the so-called Industrials, must of a necessity become prominent in the dealings of the week. The whole stock market list has continued to demonstrate that buoyancy, so characteristic of recent transactions, and, as on all occasions where real intrinsic worth is allowed an opportunity to exercise a proper influence on the course of quotations, the securities of the electric companies have not been laggards in the movement to a higher level of prices.

GENERAL ELECTRIC, being at all times more active and dominating in the stock market than any other electrical security, reflects this tendency to a more appreciable degree. Here we have a stock of a company of which nothing too bad could be said a few months ago. Wall Street for months prophesied a receivership day after day. The admissions made by the management since that time have proved how dangerously near the company was on the verge of disaster, but, ever since the true state of affairs has been communicated to the security holders and the public at large, it is really wonderful to note the change in Wall Street's sentiment regarding the General Electric Company. Wall Street appreciates that the money-making possibilities are large, and it believes that all interests have now patched up their differences and have devoted themselves to the sole purpose of so administering the affairs of the company as to make the largest profits possible at a minimum expenditure of gross receipts. Note was made in these columns some weeks ago of the good feeling that had resulted from the results of an investigation of the company that a prominent Broad street commission house had made in behalf of such of its foreign clients as are large holders of General Electric securities. In the same way one of the representatives of large Dutch interests, who recently came to America to make a study of railroad properties, took occasion to make an exhaustive analysis of the General Electric's condition and possibilities. The results have convinced him that all bearish feeling regarding the property, so far as its intrinsic value is concerned, are unwarranted by fact, and that the uneasiness occasioned by the misfortunes of the General Electric Company in 1893 can now be allayed with a perfect confidence that the company is once more on the money-making road. Of course the stockholders must still face the necessity of reducing the capital stock to make up for the enormous shrinkage in assets. But Wall Street is disposed even to regard this as a favorable move, and the stock this week was firmest when it was announced that progress had been made in the plan for the early reduction of the capital stock to $15,000,000, so that dividends on the preferred could be resumed at no distant date. As a matter of fact, the matter of making good the impairment of capital has not yet reached such a stage as to allow of any definite announcement regarding the board of directors' plans. One of its members says that the question has not even been brought up as a matter of business at any directors' meeting held since the annual stockholders' meeting last month. To be sure the subject is frequently a source of informal discussion, and enough is being said about it in this way to warrant the statement that when the board does take the matter up, its members will all have agreed beforehand on the plan which will be submitted to a special stockholders' meeting for approval. This same director, in speaking of other matters affecting the company's future policy, says: "The question of a dividend on the preferred stock will not be considered until after the impairment of capital is settled. In regard to the filling of the two additions to the board of directors, authorized at the stockholders' meeting, nothing has yet been done. There will be a meeting this month, and some action may be taken. The business of the company is progressing as well as was expected. It is receiving its full share of orders, and is filling them promptly." The friends of the General Electric Company have been particularly jubilant over the decision in what is known as the "Oconto" case, the real title of the case being the Edison Electric Light Company versus the Electric Manufacturing Company, of Oconto, Wis. The United States Court of Appeals at Milwaukee makes its decision entirely in favor of the General Electric Company, holding that the Edison lamp patent, pendente lite, should be protected against invasion.

WESTERN UNION TELEGRAPH stock has emerged from the obscurity in which it has been plunged of recent weeks, and some lively speculation has been indulged in this week. The people who have been buying the stock are extremely confident in their assertion that higher prices are close at hand. They argue that there is no reason why Western Union should sell down in a 1 per cent. money market, but there is every reason to expect higher quotations. An official at 195 Broadway (the executive offices are located there) makes the assertion that, while the net earnings for the year have not yet been so compiled that any one knows exactly what they will show, none the less it can be said that the reduction in operating expenses will offset whatever losses have been incurred through the falling off of business. "The Western Union Telegraph Company," he adds, "does not owe a single dollar; that is to say, it has not a dollar of floating debt. On the contrary, it has a surplus fund of from $6,000,000 to $7,000,000. The dividend for the July quarter, gauged by present business, will be earned and paid at the regular rate of 5 per cent." Leading bull operators venture the prediction that Western Union will soon be made the pivotal stock of the whole market on the upward, and this can be done because of the very small amount of floating stock. The transfer books show that out of 1,000,000 shares but 80,000 are floating in brokers' names, and of this amount at least 20,000 shares belong to private parties, who could take them up at any moment. There being then but 60,000 out of 1,000,000 shares left to trade, it can easily be imagined that it would not take much manipulation to corner the stock and make the lives of such traders as are willing to put out short contracts very unhappy. The investment demand for this specialty breaks all records, and, with the exception of the Lackawanna Railroad, there is no other corporation of similar magnitude with the Western Union whose securities are listed on the Stock Exchange that has fewer shares afloat. Strange as it may seem, there are bears who see even in this distribution of stock in the hands of investors a depressing argument, because, so they say, "if it was found necessary to reduce dividends, the stock would come out very fast and make one of the old-time breaks common enough when the general public was carrying a great many stocks." There doesn't seem to be much likelihood just now of a reduction in dividends, however. None the less there are bears on the stock. One of them, the head of a large Chicago house, is quoted by Dow, Jones & Co. as follows: "I think that the people who buy Western Union will see a loss on their investment, principally on account of the strides which are being made by the opposition companies. The telephone company is taking business by its better wires. The Commercial Cable Company is getting the cream of the cable business, and the Postal company is preferred in many localities on account of its better service. This, with Western Union's big capital, entails a burden which I expect to see reflected in an enforced reduction in dividends and a consequent decline in the stock." It is to be remembered, however, that this is the bear version.

WESTINGHOUSE ELECTRIC matters for the moment are quiet. The speculation in its stock issues is, for the time being, very light, but people who are in touch with the management, and are familiar with its present business and future prospects, are keeping a sharp eye on the two classes of stock. The annual meeting of the stockholders of the Westinghouse Electric Company will be held at Pittsburgh on the 16th inst. The annual report will be issued next week by the directors of the company. It will, it is promised, make a surprisingly good showing. Regarding the current business of the company, it is reported that during the month of March the floating debt was reduced $200,000. This leaves the amount still payable around $500,000. It is said that the company's bills receivable are more than ample to wipe this out entirely whenever it is deemed advisable.

EDISON ELECTRIC ILLUMINATING (New York) bonds continue in prime demand. The feature of the financial month just ended has been the inquiry after good bonds, due to the desire of the large amounts of idle money in this city to find more remunerative returns than loan rates on the Street afford. Edison Illuminating bonds have been regarded as a gilt-edged investment, and the price, 107¾ for a 5 per cent. bond, is good evidence how well looked upon these securities are.

ELECTRICAL STOCKS.

	Par	Bid.	Asked.
Brush Ill., New York	50	10	30
Detroit Electrical Works	10	2	3
Cleveland General Electric Co	—	85	90
East River Electric Light	100	—	65
Electric Con. & Supply Co., pref	15	15	16
" " " com	15	15	17½
Edison Electric Ill., New York	100	100	102
" " " 1sts	—	107¼	107½
Edison Electric Ill., Brooklyn	100	103	104
" " " Boston	100	115	120
" " " Chicago	100	130	135
" " " Philadelphia	100	130	135
Edison Electric Light of Europe	—	—	3
" Bonds	—	80	85
" Ore Milling	—	10	11
Fort Wayne Electric	—	4½	6½
General Electric Company	100	38¼	38½
" " " deb. 5's	—	86¾	87¼
Interior Conduit and Ins. Co	100	35	50
Mount Morris Electric		—	65
Westinghouse Consolidated	50	36	37½
" " " pref.	50	51½	52½
Western Union Telegraph	—	84¾	84⅞
American Bell Telephone	—	189	190

*Ex. dividend.

New Incorporations.

THE INTER-URBAN RAPID TRANSIT COMPANY, Trenton, N. J., capital stock $1,000,000, has been incorporated.

THE CALIFORNIA GROUND ELECTRICAL COMPANY, San Francisco, Cal., capital stock $100,000, has been incorporated to deal in and operate electrical inventions and devices. Frank Shay, G. W. Schell, D. Spencer, L. C. Branch, and N. M. Fay, San Francisco, Cal., are the promoters.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Chicago, Ill., capital stock $4,000, has been formed to manufacture and deal in electrical appliances and supplies. H. H. Cutler, E. W. Hammer, and R. L. Commons are interested.

THE GLENCOE ELECTRIC COMPANY, Chicago, Ill., capital

stock $3,000, has been incorporated by John Flanning and others.

THE ELECTROLYTIC REDUCTION COMPANY, San Francisco, Cal., capital stock $1,000,000, has been formed to mine and reduce ores.

THE ELECTRO-METALLIC BRICK COMPANY, Chicago, Ill., capital stock $300,000, has been incorporated by J. E. Robinson and others.

THE JERSEYVILLE TELEPHONE COMPANY, Jerseyville, Ill., has been incorporated by J. G. Swartz and others. The capital stock is $5,000.

THE IMPERIAL ELECTRIC LAMP COMPANY, New York, has been incorporated with a capital stock of $250,000 by J. F. Wood and others.

THE TELEPHONE EXCHANGE COMPANY, of Seneca, Kan., has been incorporated by J. A. Gilchrist and others. The capital stock is $25,000.

THE NEMAHA TELEPHONE EXCHANGE COMPANY, Seneca, Kan., capital stock $25,000, has been incorporated by J. D. Kennard and others.

THE SPECIAL FIRE ALARM SIGNAL COMPANY, New York, has been incorporated by Frederick Pearce and others. The capital stock is $50,000.

THE CHICAGO AND MORGAN PARK ELECTRIC STREET RAILWAY COMPANY, Chicago, Ill., capital stock $500,000, has been formed by F. Dean.

THE HILLSBORO INVESTMENT AND ELECTRIC COMPANY, Hillsboro, Tex., capital stock $50,000, has been organized to supply electric power, gas, etc.

THE INTERSTATE CONSTRUCTION COMPANY, Des Moines, Iowa, capital stock $500,000, has been incorporated by E. I. Rosenfeld and others to construct and operate railway and telegraph lines.

BAKER CITY, ORE.—The Baker City Electric Light Company has been incorporated with a capital of $60,000, to erect and maintain an electric light plant. Jos. A. West and C. W. Nibley, Jr., are interested.

THE ROSE ELECTRIC COMPANY, St. Louis, Mo., capital stock $40,000, has been formed to manufacture and deal in electrical machinery, etc. P. L. Rose, A. E. Rose and Matilda Rose, of St. Louis, are the incorporators.

THE INTER-COUNTY STREET RAILWAY COMPANY, Tamaqua, Pa., capital stock $200,000, has been incorporated to construct and operate a street railway. C. E. Hogue, S. Friedberger, J. C. Dedier, Philadelphia, Pa., are the incorporators.

THE DOBBS FERRY LIGHTING COMPANY, Dobbs Ferry, N. Y., capital stock $40,000, has been incorporated to supply electric light, heat and power. G. C. Todd, G. F. Cameron and Oliver Snow, Tarrytown, N. Y., are the organizers.

THE IMPERIAL ELECTRIC LAMP COMPANY, New York, capital stock $250,000, has been formed to manufacture electric lamps and appliances. H. F. Rogers, J. F. Wood, Huntington, and R. I. Murray, Chappaqua, N. Y., are interested.

THE PORTLAND ELECTRIC WORKS, Portland, Me., capital stock $50,000, has been formed to make and sell all kinds of electrical supplies. The promoters are Nathan E. Redlon, Chas. O. Files, Howard Gould and H. G. Bennett, Portland, Me.

THE GENEVA CONSTRUCTION COMPANY, Trenton, N. J., capital stock $25,000, has been formed to take contracts for the construction of railroads, electric light plants, etc. J. B. Reilly, Thos. Craig, Trenton, N. J., and J. F. Dolan, New York, are the promoters.

THE LIVGRO INCANDESCENT LAMP COMPANY, Harrison, N. J., capital stock $1,000,000, has been formed to manufacture and sell incandescent electric lamps. W. E. Forest, A. H. Gross, Jos. Livingston, New York City, and C. M. Myers, Newark, N. J., are interested.

THE LORAINE MACHINE COMPANY, New York, capital stock $1,800, has been incorporated to manufacture electrical and mechanical machines. Jerome Bradley, 5 Dey street; W. M. Earl, 32 West 128th street, and H. H. Gevel, 5 Ridge place, New York, are the promoters.

THE STATE BELT ELECTRIC STREET RAILWAY COMPANY, Bangor, Me, capital stock $200,000, has been formed to construct and operate an electric street railway. The organizers are C. A. Oakes, Brooklyn, N. Y.; C. Shuman, Bath, and G. W. Mackey, Bangor, Me.

THE MARION STREET RAILWAY COMPANY, Marion, Ohio, capital stock $100,000, has been formed to construct and operate street railways and to furnish light, heat, power, etc. E. Durfee, C. E. Turner, G. Liffler, E. Huber, H. Strelitz and G. E. Burlow are the incorporators.

THE GEO. L. COLGATE COMPANY, New York, capital stock $20,000, has been formed to manufacture electrical machinery. The interested parties are G. L. Colgate, Fanwood, N. J.; G. O. Van Voast, Jr., 543 Herkimer street, and I. A. Stevenson, 394 Shepard avenue, Brooklyn, N. Y.

THE MASON ELECTRIC COMPANY, Chicago, Ill., capital stock $10,000, has been organized to manufacture, buy and sell machinery used in equipping or constructing electric railways, mining plants or kindred interests, and also to construct electric railways. The promoters are Norman Totten, F. A. Moore and Manton Maverick.

THE DEWEY ELECTRIC SIGNAL COMPANY, Jersey City, N. J., capital stock $60,000, has been formed to manufacture, buy and sell machinery, lamps, motors, etc., appertaining to, or connected with, the production, distribution, etc., of electricity for signaling power. A. M. Dodge, J. F. Tams, New York; F. G. Ingersoll, New Haven, Conn.; E. B. Wyman, Highwood, and G. B. Hollister, Rutherford, N. J., are the promoters.

Special Correspondence.

New York Notes.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, May 7, 1894.

MR. FRANK FULLER, of Seth W. Fuller, manufacturer of electric apparatus, 27 Arch street, Boston, Mass., was in town last week.

MR. EDWARD J. DALTON, manager of M. T. Davidson's New York office, 77 Liberty street, reports having sold a number of steam pumps to electrical plants during the past week.

New England Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., May 5, 1894.

BURTON E. BAKER, formerly of the Thomson-Houston company, with offices in the Whittlesey Block, New Britain, Conn., is forming the Improved Electrical Machine Company, to manufacture electrical appliances.

THE WATERHOUSE ARC LAMP for incandescent and arc circuits has been adopted by the Boston and Maine Railroad Company for the Union Station in Boston. The order was obtained by Mr. F. G. Waterhouse personally.

THE PETTINGELL-ANDREWS COMPANY, Boston, has just been awarded a nice contract by the Union Street Railway Company, Providence, R. I., for the overhead construction of its Pawtuxet Valley and Pawtucket Street Railway divisions.

THE BILL to permit cities and towns to construct, maintain and lease conduits for electric wires, cables and conductors has been rejected by the House of the Massachusetts Legislature by a vote of 73 to 61, but its author, it is said, will endeavor to get a reconsideration.

MR. E. W. LITTLE, vice president of the Interior Conduit and Insulation Company, and Mr. Jean A. Wetmore, of the Okonite Company, were Boston visitors this week. Their headquarters were, of course, at the offices of the Pettingell-Andrews Company, their New England agency.

THE DAY-MOBERG ELECTRIC COMPANY, Boston, has removed its office and factory to 185 Franklin street, where it has greater convenience for the manufacture of its storage battery—the "Jupiter"—and other specialties, and the general conduct of its rapidly growing business.

MR. LINTON, of Linton & Southwick, Worcester, Mass., favored this office with a call this week, and reports the demand for his switches as constantly on the increase. This firm makes a specialty of the manufacture of switches of superior grade and at extremely low prices, and will very soon place on the market another and improved switch.

MR. ALEXANDER JAY WURTZ, of the Westinghouse Electric Company, delivered an interesting lecture Monday evening, April 30, on "Non-Arcing Lightning Arresters," before the Society of Arts, Boston. The students of the Institute of Technology were out in good numbers and gave the lecturer a hearty reception, and the able address of Mr. Wurtz on this very important subject commanded the closest attention of all present.

THE MEIGS ELEVATED RAILWAY MEASURE is commented upon by the Boston "Transcript" as follows: "The transit committee's report is the beginning rather than the end of the matter, for the Meigs bill will have a thorough overhauling by the finance committee in its monetary provisions; and as to its physical features, there are on the Senate table the petitions of White and Boynton and Mack, each with a bill ready to be brought forward at the fitting moment to supplant and succeed the bill reported by the transit committee."

Pittsburg Notes.

PITTSBURG, May 4, 1894.

THE EDISON GENERAL ELECTRIC COMPANY has filed a suit in the United States Court in this city against the Uniontown Street Railway Company, to recover $5,000. The amount is claimed to be due on a promissory note, for which payment was refused when it fell due.

DIRECTOR McAFEE, of the Department of Public Works, Allegheny, is particularly interested in a device for supporting electric light wires. His plan is to place the electric light wires in an arch in the middle of the street, and thus do away with the mast-arm system. Mr. McAfee expects that his method will greatly add to the improvement of the streets. In giving an explanation of the system, he said that he intended to erect an arch 40 feet above the street. This arch is to be constructed of structural iron or steel, and will be anchored under the street on stone foundations. The weight of the wires will act as a brace, and as a result no guy wires will be necessary. They may be placed a much greater distance apart than the mast arms are now. At a height of about 30 feet the crossbars and pendant will be placed and on these will be a place from which the arc lamps are to be suspended. At a certain distance below there will be room made for the trolley wires. Resting on the crossbar and braced by the rising curve of the arch is to be an immense frame on which to string the wires. Below and above the street railway feed wires are to be attached, and then the city and other electric light wires. Again, some distance above these is the place for the telegraph wires, and, at last, even higher than these, the city fire and police wires. While speaking about this proposed system Mr. McAfee remarked: "My idea to adopt this method is, because it is cheaper than the underground plan, has some advantages over that method, and also because I think it would be easier to induce the street railway and electric light companies to adopt this system than the underground plan. Underground currents of electricity have a bad effect upon the water lines. My system will not interfere with the firemen in case of fire, and I also think these arches will, to some extent, enhance the appearance of streets; at all events it will be a manifest improvement upon the unsightly poles of the present." The director has had an ordinance drawn up upon this matter, which will be presented before councils in a few days, and, owing to the influential position of Mr. McAfee, it is very likely that the matter will be approved of.

Western Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 Monadnock Building CHICAGO, May 4, 1894.

THE GREAT WESTERN MANUFACTURING COMPANY, finding its old quarters in South Canal street inadequate for the enormous business which it is doing at present, has decided to move to new and commodious apartments at 116, 118, 120 Market street, Here it will have one of the best equipped houses in Chicago, and is to be congratulated on this important move. The manager, H. K. Gillman, is winning a great many compliments because of his able management of this firm. It seems to have gone steadily forward from its incorporation, until it is now recognized as one of the leading houses of the West. The works at Duluth are crowded more than ever with orders, and every one connected with the company cannot but feel the spirit of progress which is at present so manifest.

Canadian Notes.

OTTAWA, Ont., May 4, 1894.

OTTAWA, ONT.—The Bell Telephone Company has a bill before the Dominion Parliament, which takes authority to issue bonds or debentures to the amount of 75 per cent. of its paid up capital stock. As this is $2,500,000, the new issue amounts to over $1,700,000.

TORONTO, ONT.—E. N. Cooke, representing the Western Electrical Manufacturing Company, of Chicago, has been in the city, where he is anxious to establish a branch of the company's business. He also had a conference with the city engineer with reference to putting in an electric lighting plant for the city. He will look over the ground and then submit an estimate for the work. The city engineer has sent a circular to several different electric companies, asking for a similar estimate.

ST. JOHN, N. B.—Mr. Van Horne and James Ross on their return from Ottawa will proceed at once to St. John for the purpose of maturing the plans for the extension of their newly acquired electrical and street railway plant. This comprises the charters of three different companies, which were bought for $92,000. The new owners intend double-tracking the road, and extending both it and the electric light to the adjoining suburbs, for which purpose they expect to expend the sum of $400,000.

HAMILTON, ONT.—Mayor Stewart had a conference with the directors of the Hamilton Electric Light and Power Company this week, in reference to the renewal of contract for lighting the city. The electric light company say they will renew the contract for five years at the old figure, but if the contract is to be for only one year the figure will be higher. Frank B. Rae, the electrical expert of Detroit, will meet the Board of Works, when it is probable he will be engaged to prepare a report on the proposed plan to establish municipal electric light works.

WINNIPEG, MAN.—For some time nothing has been heard of the proposed electrical railway from Winnipeg to Selkirk, but negotiations have been going on, and, as a result, operations will commence this spring. F. W. Colcleugh, who holds the charter, has been in communication with A. W. Austin, of the Winnipeg Street Railway, to construct the road while he (Mr. Austin) has been away in England, and the reply was that nothing could be done until the return of Mr. Austin to the city, and that in the meantime the company make no arrangements with other parties to go on with the work. Upon Mr. Austin's return the matter will be discussed with him, and it is understood that he is willing to make a contract with the company. Besides this, Duluth capital will be forthcoming to build the road, should it be wanted, and if Mr. Austin will not take hold the American money will be utilized. In either event work will be proceeded with this spring.

English Notes.

(From Our Own English Correspondent.)

LONDON, England, April 18, 1894.

MUNICIPAL ELECTRIC LIGHTING.—The Town Council of the well known south coast seaside resort of Folkestone has decided to spend £35,000 on a municipal electric lighting scheme.

ELECTRIC PUMPING.—The Worcester City Council, whose municipal electric supply station, driven by water power, will shortly be opened, propose to give their station a day load by employing electric motors geared to three-throw pumps to perform the necessary pumping work at the municipal water works.

ELECTRIC MINING MACHINES.—Considering the trouble which the coal owners have had in the past, and are likely to have in the immediate future, with their workmen, it seems somewhat strange that more attention has not been paid by colliery owners to the introduction of mechanical appliances for the winning of coal. This question was raised recently in a paper read before the Manchester Geological Society, and in the discussion that followed a government inspector of mining remarked that the "Hurd" pneumatic electrical cutting machine, which had been exhibited at that meeting, seemed to be more adapted for a long wall, whilst in Lancashire the system of working was mostly "pillar and stall." Another member remarked that the reason that coal cutting machines had not been adopted in Lancashire was not that there was any prejudice against them or unwillingness on the part of the coal owners to adopt mechanical appliances, but simply because machines had not been produced capable of working successfully with the bad roofs they had in most of the mines.

UNDERGROUND MAINS.—Some interesting information was given to the public at a recent meeting of the Northern Society of Electrical Engineers upon various points connected with underground mains. Mr. Crompton, the founder of the bare-copper strip system, has always maintained that the cost of maintenance of mains laid in this way would turn out to be "next to nothing." The following figures for the South Kensington mains, it must be admitted, substantiate this claim. The total cost for laying mains in Kensington amounts to £56,000, of which by far the greater part was spent in the years 1891 and 1892. The cost of maintenance, including all repairs to surface boxes, caused by wearing away of cement, modifications in paving, resetting of boxes caused by reflagging, etc., comes out at considerably under 5 per cent. per annum on the capital outlay. In the matter of insulation also, about which there has been considerable doubt, it is found that at Hove, in wet weather, the average insulation resistance runs from .35 to .5 megohm per mile, and in dry weather from 2 to 3 megohms. Mr. Callender, of Callender's Bitumen Telegraph and Waterproof Company, pointed out that of the 82 stations at present at work in the United Kingdom, only 19 used throughout rubber insulated cables, whilst 39 used throughout cables insulated by materials other than rubber. Several members of the society expressed decidedly favorable opinions as regards paper insulated lead covered cables. Mr. Nisbett, of the City of London Electric Lighting Company, gave the following example of the flexibility of a paper insulated cable, the cable being a treble concentric cable of 1½ inch diameter: The cable was bent to a 30-feet radius and straightened, and a pressure of 4,500 volts was then applied, and successfully withstood, the cable being designed to work at 200 volts only. There was also a consensus of opinion in favor of keeping the various sections of network separate, so as to avoid the possibility of a single fault on the big system jeopardizing the entire network.

ELECTRICAL MISCELLANEA AT THE INSTITUTION OF ELECTRICAL ENGINEERS.—In the programme of the Institution of Electrical Engineers there was recently a gap, and Professor Ayrton obligingly came forward to fill it with a miscellaneous sheaf of short papers dealing with a universal shunt for galvanometers, devised by himself and Mr. Mather, the best resistance for the receiving instrument on a leaky telegraph circuit, a transparent conducting screen for electrical and other instruments and an astatic station voltmeter. The transparent conducting screen devised by Professor Ayrton and Mr. Mather for use with electric and other instruments is considered by them to be necessitated by the occasional powerful electrostatic effects which arise from the glass of such instrument being accidentally or intentionally rubbed. As an example of what might possibly take place in a warmed up and possibly dry engine room, Professor Ayrton showed that after one or two vigorous rubs with a pocket-handkerchief the glass face of a Schuckert voltmeter was so charged that the aluminium pointer was deflected to the position of 40 volts, a 16-c. p. glow lamp having been warming up the face for some 20 minutes beforehand. To make sure that this cause of error shall not have any effect, Professor Ayrton and Mr. Mather have devised their transparent conducting coating, which is

to be applied on the inner side of instrument faces. The recipe is to dissolve one-quarter of an ounce of transparent gelatine with one ounce of glacial acetic acid by heating them together in a water bath at 100 degrees Centigrade, and to add to this solution half the volume of dilute sulphuric acid, prepared by mixing one part of strong acid with eight of distilled water by volume, the mixture being applied while still warm to the glass shade, which should be previously polished and be warm. When this film has become nearly dry, a coating of Griffith's anti-sulphuric enamel should be applied. Several voltmeters were shown treated in this manner. It is interesting to observe that this transparent conducting screen, if we are to assume that it conducts as an ordinary conductor, and not as an electrolyte, is a flagrant contradiction of Maxwell's law that an optically transparent body must be an insulator, and that every electrical conductor must be optically opaque.

ELECTRICAL COMMUNICATION WITH LIGHTHOUSES AND LIGHTSHIPS.—The first report of the Royal Commission appointed to consider the question of electrical communication with lighthouses and lightships appeared in the beginning of last year, and the second report has just been published. The first report recommended that communication should be effected by means of a telephone cable with five lightships, one pile lighthouse and three rock lighthouses; the Fastnet light of the south of Ireland, to be electrically connected with the shore by means of a non-continuous cable. These recommendations were in addition to those relating to the connection of some 18 lighthouses with the general telegraphic system of the country. The total cost of carrying out the recommendations of the committee were estimated at £25,000. At the time of wiring all the shore lighthouses referred to in the first report have been connected, and two out of the five lightships have just been telephonically connected with the shore. In the second report now issued some 19 more lighthouses are scheduled for electric connection with life saving stations, at an estimated cost of £1,800. The Royal Commission state that they received and considered particulars of a number of inventions for effecting electrical communication between light vessels and the shore, but none of these are, in their opinion, preferable to the method adopted on the Goodwin and Kentish Knock lightships, to which I referred in a recent letter. The report concludes as follows: "It is with regret that we have decided to confine our recommendations in this report to shore lighthouses, but until more has been done towards effecting the connection of those light vessels, which we selected in our first report as having the strongest claims to immediate attention, we hesitate to add to the list of light vessels, island and rock lighthouses with which we consider that electrical communication should be established." There is a valuable appendix prepared by Sir Edward Birbeck, relating to the system of coast communication in vogue in Canada and the United States. Sir Edward Birbeck was much struck by what he saw on the coast of the Gulf of St. Lawrence and along the coast of New Jersey, and he states his opinion that the maximum efficiency would be secured if the American system of running the telegraph lines along the coast were adopted in England, instead of the zigzag system of communication through inland post-offices. He points out that neither in Canada nor the United States is there a single instance of a rock light house or light vessel being placed in electric communication with the shore.

News of the Week.

Telegraph and Telephone.

WHARTON, TEX.—The Sorrell Brothers Company will put in a telephone line 4½ miles long.

BROOKVILLE, IND., is anxious to have the telephone, and has recently granted a franchise to M. H. Irwin, publisher of the "Franklin Democrat," and John G. Goudie.

WASHINGTON, D. C.—The Chesapeake and Potomac Telephone Company has declared a dividend of 50 cents per share, and announces that from May 1, 1894, its charges for each set of telephone instruments will be $10, instead of $15 per annum, as heretofore.

Electric Light and Power.

YUMA, ARIZ.—A franchise has been granted to G. A. Allen to build an electric light plant.

AURORA, ILL.—The Brush Electric Light and Power Company has surrendered its charter.

SHORT CREEK, ALA.—W. T. McCoy and W. M. McKnight are to establish an electric light plant.

TALMAGE, NEB.—A company is being organized to put in electric lights. Henry Renkin is interested.

JACKSON, TENN.—Bids will be received to June 1 for 40 to 50 arc lights for five years. S. C. Lancaster is city engineer.

HAMBURG, IOWA.—J. P. Smith, of Weeping Water, Neb., is seeking a franchise to establish an electric lighting plant in Hamburg.

BLAINE, WASH.—The Blaine Electric Light and Power Company is recorded as having appointed Frank W. Hawkins receiver.

KALAMAZOO, MICH.—It is stated that the Kalamazoo authorities will lease the Buchanan water power for their electric light plant.

MINNEAPOLIS, MINN.—An electric light plant is to be established by W. D. Packard, of Warren, Ohio; the capacity will be 1,000 lamps.

SYCAMORE, ILL.—The Sycamore Electric Light Company is talking of erecting a new plant, the capacity of the present one being insufficient.

MONTREAL, CAN.—The plant of the Royal Electric Light Company, at Prince and William streets, has been burned; the loss is very heavy.

DETROIT, MICH.—The Palmer Log Cabin Park Syndicate will erect an electric lighting plant. John W. Lincock, 21 State street, Detroit, is interested.

MANISTEE, MICH.—The Sands Electric Lighting Company has installed a 4,000-h. p. Reynolds-Corliss engine, thus increasing the steam plant to 700 h. p.

FORSYTH, GA.—An election will be held May 18 to vote on the matter of issuing $7,000 in bonds for an electric lighting plant. R. G. Anderson is city clerk.

MONTCLAIR, N. J.—The Baker ordinance, covering the matter of an electric lighting plant for Montclair, was read and laid over indefinitely. There is strong objection to the cost.

GENESEO, N. Y.—Taxpayers have approved at the polls the intended award of contract for electric lighting to the Geneseo Gas Company. Lights to be ready Oct. 1 next.

ITHACA, MICH.—The Ithaca Electric Light Company has offered to furnish lights at $70 per annum apiece, which was referred to a committee consisting of Trustees Lewis and Franker.

PHILADELPHIA, PA.—The suggestion of the Roxborough Improvement Company for using the power of Wissahickon Creek for an electric plant was discussed and referred to a sub-committee.

COLUMBUS, OHIO.—The committee in the matter of establishing an electric light plant has recommended that a power house be established near the penitentiary, with room for additions in the future; the estimated cost is $25,000.

FOSTORIA, OHIO.—The creditors of the Fostoria Light and Power Company have taken possession of the plant, and it is stated that they will enlarge same and put in additional dynamos. They may also add dynamos for incandescent lights.

The Electric Railway.

ALTON, ILL.—The Alton Electric Street Railway Company is about to construct 10 miles of electric railway.

PEEKSKILL, N. Y.—The scheme to build an electric railway in Peekskill has been abandoned for the present.

CONCORD, N. H.—A hearing will be given May 31 on the petition of the Concord Street Railway for right to extend its tracks.

WASHINGTON, D. C.—A company is being organized to construct an electric railway between Washington and Manassas, Va.

PORTSMOUTH, VA.—L. R. Watts is president of the reorganized street railway company, and the railway will be improved.

CANANDAIGUA, N. Y.—The village trustees have given permission to an electric railway company to lay tracks through the streets.

LAWRENCE, MASS.—The petition of the Lowell, Lawrence and Haverhill Street Railway for right to extend its tracks will be heard May 7.

CINCINNATI, OHIO.—The Cincinnati Street Railway Company has secured a building permit to erect a power house at Depot and Smith streets.

DEARBORN, MICH.—The City and Suburban Traction Company has been granted a franchise to construct and operate an electric street railway on Michigan avenue.

NEWARK, N. J.—The Consolidated Traction Company has begun work on a large car house on Blanchard street, from plans of the Penn Steel Company, to cost $30,000.

TONAWANDA, N. Y.—The Tonawanda trustees have granted an extension of time to the Niagara Falls and Buffalo Street Railway Company for the completion of its line.

LANSFORD, PA.—Chas. H. Hague is president of the recently incorporated Inter-County Electric Railway, which will build and operate an electric road from Lansford to Tamaqua.

TROY, N. Y.—The Troy and New England Company, which holds a charter for an electric line from Troy to Sandlake and Albia, has virtually decided to begin work at once on a plant.

HARRISBURG, PA.—A charter has been granted to the State Belt Electric Street Railway Company to run from Bangor to Pen Argyl and Wing Gap, in Northampton county, to cost $200,000.

BROOKLYN, N. Y.—The Brooklyn Suburban and Queens County Railroad has given a contract to J. D. Murray, of New

Brunswick, N. J., to lay 25 miles of track, which it recently purchased.

OPELIKA, ALA.—The Opelika and Auburn Electric Railway Company is being organized by C. I. Daughtry and others. The road is to run from Opelika to Auburn. The capital stock will be $40,000.

CHICAGO, ILL.—An ordinance has been passed granting a franchise to the North Chicago Street Railway Company and the West Chicago Street Railway Company to equip their lines with the trolley system.

KANSAS CITY, KAN.—The county commissioners have granted a franchise to the Rosedale and Merriam Park Railway to extend its line from Rosedale south to the boundary of Johnson County. A. A. Pearson is president.

BUFFALO, N. Y.—A hearing will be given by the Common Council at 2:30 p. m., May 14, upon the petition of the Crosstown Street Railway Company for right to operate an electric street railway on certain streets.

CHICAGO, ILL.—The Metropolitan L road, which runs westward in the neighborhood of Harrison street, will be run by electricity. This decision was arrived at during a meeting held by the directors in New York.

HOOSICK, N. Y.—The highway commissioners have granted a franchise to the Hoosick Railway Company to build a street railway to North Hoosick and Wallamsuc. C. B. Story, manager, states that work will be begun at once.

NIAGARA FALLS, N. Y.—Among those interested in the proposed Niagara River Tramway Company, to build a cable tramway across the Niagara River, are R. N. Campbell, of Niagara Falls, and G. W. Pound, of Lockport, N. Y.

ELKHART, IND.—The new power house of the Home Electric Company will be built on the north side of the St. Joe River, between the Big Four Railway and the Globe Tissue Paper Works. The dimensions of the building will be 35 by 100 feet.

BROOKLYN, N. Y.—Opponents of the scheme of John W. Ambrose and the South Brooklyn Terminal Company to build a railroad from 39th street to the 26th ward have asked Mayor Schieren to veto the franchise granted by the Board of Aldermen.

PORT HURON, MICH.—The City Electric Railway will build the Lapeer avenue line as soon as the order for the repaving of Water street is issued. Their charter calls for the completion of the line this summer. Many improvements will be made.

MANCHESTER, N. H.—General Williams, of Manchester, N. H., writes to the secretary of the Board of Trade, stating that he is now figuring on an electric railway for the city, and that he will issue information from time to time as plans mature.

TIFFIN, OHIO.—The Electric Railway and Power Company, which owns several miles of street railway, thoroughly equipped, has become a part of the Tiffin Consolidated Interurban Railway Company. All the horse car lines in the city will now be equipped with electricity.

BUFFALO, N. Y.—An item in the Buffalo "Times" states that Capt. John M. Brinker is president of a company which will, in all probability, run an electric road at the bottom of the Niagara Gorge, between Lewiston and the Falls, close to the water's edge, to be opened for traffic in 1895. Majority consent for right of way has been secured.

CHICAGO, ILL.—The Chicago Construction Company has the contract for the construction of 10 miles of road for the Englewood and Chicago Electric Company, work of construction to be begun April 23. For the present the company will lease the power for its trolley lines, though eventually it is intended to build a power house by the track of the Indiana Street Railway Company. W. H. Cumstock is president, and the capital is $1,000,000.

MARION, OHIO.—The projectors of the City Street Railway have secured a franchise entirely acceptable under the existing general ordinance, which was reasonably amended. The board of seven directors, consisting of prominent business men, have elected Mr. Edward Durfee president, Mr. Godfrey Leffler vice president and Mr. G. E. Turner secretary. Mr. Turner will also serve as superintendent. The work of construction will commence at once, and four miles of road must be finished and in operation within five months. With the building of this road the Marion Electric Light and Power Company will add a large incandescent and power circuit complete.

Miscellaneous Notes.

HONORS TO FRENCH ELECTRICIANS.—As a recognition of their services, at the Chicago Exposition, the French Government has named M. J. Carpentier an officer and MM. Ch. Milde, J. Richard and Werlein, chevaliers, of the Legion of Honor.

THE NEW TRANSATLANTIC CABLE.—The London "Daily Graphic" contains a detailed description of the new transatlantic cable now being laid by the Commercial Cable Company, illustrated by a map, and views showing the construction of the cable itself.

COLUMBIA COLLEGE SCHOOL OF MINES.—Mr. Alexander Jay Wurts, of the Westinghouse Electric and Manufacturing Company, read a paper on non-arcing lightning arresters, with special reference to the protection of street railway circuits. Experiments were made with some new forms of apparatus.

RIGHT OF MUNICIPAL CORPORATIONS TO SUPPLY ELECTRICITY.—An act authorizing municipal corporations to manufacture and supply electricity at reasonable rates to the inhabitants violates no constitutional provision, this being a public service.—(Linn v. Borough of Chambersburg. Supreme Court of Pennsylvania, 28 At. Rep., 842.)

THE NEW YORK-WASHINGTON TROLLEY LINE.—The Elkins-Widener syndicate, of Philadelphia, is reported to be interested in a trolley line from New York to Washington. It is stated that it has procured a charter for an electric line from Washington and Baltimore to the Pennsylvania State line. It is also reported that the syndicate has had surveys made from Jersey City to Newark, N. J., for an electric road, and from Newark the road will certainly be extended to Philadelphia, and down through the southern suburban towns of that city. A further extension from Wilmington to Baltimore will follow.

ELECTRIC COOKING AND HEATING.—Mr. R. E. Crompton, in a recent interview in the "Pall Mall Gazette," gives some facts and figures in regard to electric cooking and heating. On a 100-volt circuit, he says it took 25 amperes to heat up a small family oven, which would then cook for nearly an hour. A frying pan requires 2½ amperes, and it costs one-third of a cent (with electricity at 8 cents per kilowatt) to heat an ordinary tea kettle. A flat iron takes from 2½ to 3 amperes of current, and a soldering iron 1½ amperes. The reporter was assured that mutton and pastry could be cooked simultaneously in the same oven with no risk of tainting the latter, the reason given being that the oven is practically hermetically sealed.

A NATIONAL SCHOOL OF ELECTRICITY.—We learn from the daily press that Prof. J. P. Barrett, of Chicago, has organized a National School of Electricity, the following officers and instructors being named: President, J. P. Barrett; vice president, J. L. Little; treasurer, E. L. Powers; secretary, J. Allan Hornsby. The faculty, in addition to specially selected local instructors, is stated to be as follows: Thomas A. Edison, dean; Nikola Tesla, Prof. Henry S. Carhart, Dr. Elisha Gray, A. M., Ph. D., LL. D.; Prof. Harris J. Ryan, M. E.; Dr. F. A. C. Perrine, Prof. William A. Anthony, Ph. B.; Prof. George D. Shepardson, Prof. Michael T. O'Dea, M. S. E. E.; Prof. Brown Ayres, Prof. Dugald C. Jackson, C. E.; Prof. Benjamin F. Thomas, Prof. J. P. Barrett. It is the intention to organize a class in electricity in every city and town the population of which is large enough to justify it. This class will meet weekly and be provided with a study leaf, which will take the place of text books. There will be one lesson a week for 40 weeks, the course to cover one year.

THE NORTHWESTERN ELEVATED RAILROAD COMPANY, of Chicago, proposes to construct a line passing through some of the Chicago buildings. This is rendered possible by the use of electricity as a motive power, so that smoke and cinders and much of the noise are avoided. The structure is to be arranged so that it rests on its own foundation entirely independent of the buildings, leaving the side spaces on each side of the track for small structures or booths. In one instance, in New York City, where an elevated railroad station is located in a building, it has been found that the value of the building for rental purposes has increased over 150 per cent. It is understood that the management of the road has decided to recommend electricity as a motive power, and that it is its purpose to build a two-track structure south of the Chicago River, and have the trains stop at every street crossing in the central portion of the city. North of the river there will be four tracks, the two inner tracks being for express trains and the two outer tracks for general business.

NEWS FROM A UNIVERSITY.—The "University Courier," of the University of Kansas, has the following item of news: "There are to be several important additions in the electrical engineering and physical departments in the way of apparatus. This is a most important step, and has long been looked forward to by everybody connected with these departments. The equipment consists of one large 100-h. p. Rustle engine, which will drive a large iron-clad direct alternating dynamo, having a capacity of 750 lights for the library building. There are to be also two high pressure boilers for the engines. The boilers are of 100-kw. capacity, and are designed to work perfectly synchronous with a large transformer, used to pump water for the boiler house. The following apparatus has been purchased for the physical laboratory: One highly finished coulomb arrester, to measure one-millionth of a "Board of Trade unit," or Joule's equivalent, by Hyche, of Berlin; a large galvanometer, wound with stadia wires, and one small Westinghouse ohm sifter. More is expected in the near future."

THE WEST VIRGINIA UNIVERSITY is building a mechanical laboratory adjacent to its mechanical shops, in which the light, heat and power plant of the university will be installed. Having this plant all under the same roof, in the department of mechanical engineering, greatly increases the facilities for instruction, as the whole plant will be available at any time for experimental work and special testing and investigation. The equipment will contain a storage battery plant, arc and incandescent dynamos and motors, electrical testing and measuring instruments, simple and compound engines installed so as to work as a triple expansion engine of 100 h. p., exhaust steam and independent jet and surface condensers, compound pumping engines for reservoir service and duty tests, high pressure sectional

boilers set for coal and natural gas firing, and the present equipment of standard engineering testing and measuring instruments and accessories will be materially increased. The university is located at Morgantown, W. Va., on the Monongahela River, and on the new link of the Baltimore and Ohio Railroad, connecting its Pittsburgh and Wheeling lines.

THE PERMANENT COMMERCIAL EXHIBIT of New York, conducted by the Pan-American Company, is a development of the foreign commercial museum, such as those of Brussels and Liverpool. This company has secured the Industrial Building, at 43d and 44th streets and Lexington avenue, New York City, and proposes to carry samples there, and at the same time offers the assistance of an organization especially valuable to conserve the interests of American manufacturers abroad in a capacity similar to that of a traveling salesman, and to collect all information through its foreign correspondents and traveling representatives that may be of interest and value that the manufacturer represents. Officers and agents of the company having a knowledge of the Spanish language will make trips through the various portions of Spanish America solely in the interests of American manufacturers who are subscribers to the enterprise, introducing their goods and collecting information for them. The company has resident agents in each of the larger cities of Spanish America, South Africa and Australia, with whom the subscribers are at liberty to correspond at all times. The company lets to various subscribers floor space in its building, which the subscribers may use as an exhibit space or a New York office, as may be desired. The objects of the company are novel, and it will no doubt meet with success.

Trade and Industrial Notes.

THE WALLACE ELECTRIC COMPANY reports a steady and rapidly increasing sale of the Wirt brush. This brush is adapted to all incandescent dynamos.

CHARLES A. SCHIEREN & CO., 47 Ferry street, New York City, have secured an order from the Brooklyn City Railroad Company for an extra belt, 91 feet long and 60 inches wide.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, of Pittsfield, Mass., will erect a new building on Renne avenue, near the station of the Pittsfield Electric Company. The building will be three stories high, 200 by 70 feet, and work will be begun as soon as plans can be prepared and contracts given out.

PALMER BROS., of Mianus, Conn., are putting an addition on their factory. The firm has just booked one order for 6,000 telephone receivers, 5,000 of them being their standard compound magnet receiver, with rubber shell, and 1,000 of a cheaper grade. The same customer has also ordered 500 complete telephones.

THE H. M. LOUD & SONS LUMBER COMPANY, of 39 Cortlandt street New York, and Au Sable, Mich., is sending to its many friends and customers samples of its superior make and finish octagonal poles, both carbolined and painted, for use on electric roads, lighting, etc. The samples are neatly mounted on cardboard.

THE FRISBIE ELEVATOR AND MANUFACTURING COMPANY, New Haven, Conn., states that its sales for the month of March far exceeded that of any one month since the existence of the company, and equal to any four ordinary months in the year. Among the many contracts secured within the past few weeks are mentioned a large order for Frisbie clutch pulleys and cut-off couplings, patent pillow blocks, hongers, shafting, etc., for the New Haven Electric Light Company's new station; a 2,000-pound Champion safety freight elevator, of its new friction pulley pattern, for The E. S. Greeley & Co.'s new warerooms, at 5 and 7 Dey street, New York; a 5-ton freight elevator, of the same pattern, for the Safety Insulated Wire and Cable Company, West 28th street, New York. Judging from the large business now coming from electric light plants throughout the country, from Maine to California, the company thinks it evident that the many points of superiority that the Frisbie clutch pulleys and cut-off couplings possess are being appreciated.

THOMAS H. FEAREY, manager of the Buffalo office of the General Electric Company, reports a large spring business. The Buffalo Railway has ordered two 800-h. p. direct coupled generators, which will be placed in its present power station and coupled to Lake Erie upright engines. These will be duplicates of the couple which did such fine work at the Intramural station at Chicago. They have also ordered G. E.-800 motors for 84 new cars. The West Side Railroad, of Elmira, has purchased two W. P.-50 equipments. The Kingston City Railway Company has bought two G. E.-800 equipments, the Seneca and Waterloo Railway one, and the Buffalo and Williamsville Railway two. The Grand View Beach Railway will install a new switchboard of the General Electric Company's make, to take the place of the one destroyed by fire. The Buffalo, Bellevue and Lancaster Railway has purchased a 150-kw. Edison generator and two W. P.-50 equipments; 2,000 h. p. of motor generators have been sold to the Cataract Construction Company, at Niagara Falls. A 150-h. p. power plant has been installed by the Niagara Falls Hydraulic Power and Manufacturing Company, and is in successful operation. The Niagara Silver Company has changed from steam to electric power, using a 75-h. p. General Electric motor. The palace car which has been used by the General Electric Company for exhibition purposes has been purchased by the Buffalo, Bellevue and Lancaster Railway. Lighting plants have been installed at the Barber Asphalt Paving Works and the Atlas Works, of the Standard Oil Company. A large trade has also been done in railway and lighting supplies and incandescent lamps.

QUEEN & CO., Philadelphia, are offering to the trade a number of instruments, excellent in design and construction, but not conforming to their regular stock, some of which were imported for exhibition purposes or for experiment, others whose place in the catalogues has been taken by later designed instruments, while others have become much shop worn by remaining on the shelves. Among the pieces which they now have on hand are a standard ohm, described in the London "Electrician," April, 1892; ammeters and voltmeters of the magnetic vane and Desprez-Carpentier types, and some manufactured by Hartmann & Braun and Schuckert; Kohlrausch spring ammeters, Siemens dynamometers anr wattmeters; a Swinburn static voltmeter and non-inductive wattmeter. This last instrument consists of a small, movable, fine wire coil in series, with a high non-inductive resistance and a coarse wire stationary coil. The fine wire is placed as a shunt across the circuit whose power is to be measured while the coarse coil is placed in series with it. A torsion screw and spring attached to the fine coil allow the needle to be fastened to it to be brought back to zero. The watts are proportionable to the torsion of the spring necessary to accomplish this. Another instrument is a balance galvanometer, devised by the General Electric Campany, to show when a voltage of a dynamo is equal to the voltage of bus bars, so that when it is thrown in circuit it may take a proper part of the load. There are also several types of galvanometers with shunt boxes, lamp stands and scales. Space in their new show rooms being imperatively necessary, Queen & Co. have decided to offer these instruments without regard to their original cost.

Business Notices.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

OPEN AND CLOSED CIRCUIT CELLS.—The Hayden carbon porous cup No. 1 cell; the Hayden carbon porous cup No. 2 cell; a Leclanche clay porous cup cell; a standard Fuller cell; a No. 2 Fuller cell; a single cylinder carbon cell; a double cylinder carbon cell. All reliable and efficient, and at prices lower than ever. THE HAYDEN-BOOKER MF'G. CO., 2140 DeKalb St., St. Louis, Mo.

THE ALLGEMEINE ELEKTRICITAETS-GESELLSCHAFT, Berlin, Germany, announce herewith that, owing to the general appreciation which their exhibition has met at the World's Fair, it is their intention to appoint selling agents in New York, Chicago, Cincinnati, Atlanta, San Francisco, Boston, Philadelphia, St. Paul, Washington, Denver, etc., for the sale of their manufacture. Trustworthy electrical firms inclined to handle their goods are requested to forward offers to the head offices, 22 Schiffbauerdamm, N. W. Berlin.

Illustrated Record of Electrical Patents.

U. S. PATENTS ISSUED APRIL 24, 1894.

518,604. ELECTRICAL CALCULATING SYSTEM; H. Hollerith, Washington, D. C. Application filed Dec. 9, 1892. This comprises an integrator, registers, switch mechanism intermediate the registers and integrator, record card, master circuit controlling the integrator, gauge contacts and circuit closer for the master circuit.

518,613. PROTECTOR FOR ELECTRIC OR OTHER BELLS; L. R. Lecellier, Villedieu, France. Application filed July 31, 1893. A cover for electric bells having lock tumblers adapted to be brought into position to operate the bell by the action of a key.

518,654. ELECTRIC ARC LAMP; R. Segerdahl, Chicago, Ill. Application filed Sept. 29, 1893. A lamp having its controlling lever movable with the shunt magnet electrode and a tension spring adapted to establish the arc between the respective electrodes of the lamp and means to regulate the tension of the spring.

518,667. ELECTRIC LOCK; J. Eldon, Lockhaven, Pa. Application filed Oct. 31, 1893. A lock having its bolt operated by the rotation of the shaft of an electric motor.

518,673. ELECTRICAL DEVICE FOR TOWING VEHICLES; T. P. Milligan, South Orange, N. J. Application filed June 3, 1893. This comprises a fixed rail, a carriage sustaining an electric motor and geared to the rail, a drag rope attached to the carriage for directing current to the motor, and a pull rope for actuating the switch lever.

518,693. CONTROLLING SWITCH FOR ELECTRIC RAILWAYS; P. Lange, Newark, N. J., and B. G. Lamme, Pittsburgh, Pa. Application filed Feb. 25, 1893. In an electrically propelled vehicle, two motors for driving the same, permanently connected in series and having their armatures next each other in the series.

518,695. CONDUIT ELECTRIC RAILWAY; C. A. Maynard, Springfield, Mass. Application filed Feb. 9, 1894. The combination with the return wire removed from the conduit and with removable covers, of auxiliary wires to connect the two.

518,713. SUPPORT FOR ELECTRIC LIGHTS; W. H. Connell, Wilmington, Del. Application filed March 28, 1893. The combination with a desk having pigeon holes, of an electric light mounted on a carriage adapted to be moved in and out of the pigeon holes, an electric circuit, and means for opening and closing the circuit.

518,719. ELECTRIC ARC LAMP; C. Hoffmann, Berlin, Germany. Application filed Sept. 28, 1893. The combination of a weighted carbon carrier, a flexible support therefor, means for feeding the carbon, an electromagnet for bringing the carbons into apposition, and auxiliary means in shunt with the magnet for maintaining their juxtapositions.

518,722. FIRE ALARM BOX; W. H. Kirnan, Bayonne, N. J. Application filed Jan. 31, 1894. The combination of a signal box, lever engaging the disabled device, and a lever for operating the pull of the box, both levers being operated by a key.

518,738. APPARATUS FOR NEUTRALIZING THE EFFECTS OF SELF INDUCTION IN ALTERNATING CURRENT CIRCUITS; J. F. Kelly and C. C. Chesney, Pittsfield, Mass. Application filed Nov. 18, 1893. This comprises a transformer having its primary in derivation to an alternating working circuit, and a condenser in the circuit of its secondary, the transformer and condenser being proportioned to produce in the current in the primary of the transformer a negative lag for neutralizing the effects of the self induction of the working circuit.

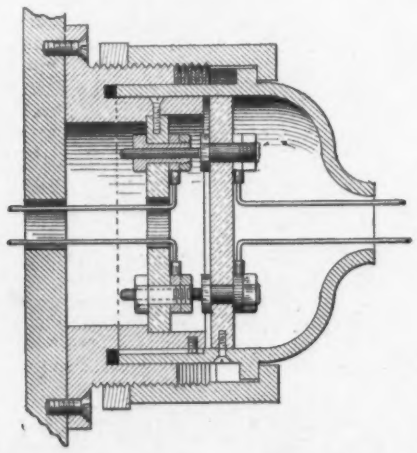
518,740. ALTERNATE CURRENT DYNAMO; J. F. Kelly, Pittsfield, Mass. Application filed Dec. 22, 1893. This comprises polar projections in combination with induced coils thereon, and a yoke bridging the projections, the reluctance of the body being high relatively to that of the projections.

518,742. TELEPHONY; W. C. Lockwood, New York, N. Y. Application filed June 27, 1892. An electrode for telephone transmitters consisting of chloride of silver.

518,756. ARMATURE FOR DYNAMO ELECTRIC MACHINES OR ELECTRIC MOTORS; T. H. Hicks, Detroit, Mich. Application filed Jan. 9, 1893. An armature having a magnetizable cylinder supported to rotate with the shaft by flanges and non-conducting material.

518,768. DYNAMO ELECTRIC MACHINE OR MOTOR; A. L. Riker, New York, N. Y. Application filed Jan. 29, 1894. A gas and watertight terminal block comprising a base and a cover adapted to fit over the base, packing interposed in the joint between the parts, and means for clamping the parts together.

518,773. TELEPHONE SYSTEM; U. H. Balsley, Philadelphia, Pa. Application filed April 29, 1889. This comprises two guides, contacts guided thereby and respectively connected therewith, a two-contact switch plug, connecting flexible conductors connecting the two contacts of the plug respectively with those guided by the guides, and line wires from the subscriber connecting with the insulated guides.



NO. 518,768.—DYNAMO OR MOTOR.

518,781. ELECTRIC OPERATING MECHANISM FOR VEHICLES; L. E. Freeley, Boston, Mass. Application filed Dec. 29, 1893. The combination of a vehicle body, running gear therefor, a brake mechanism, an electric motor for setting the brake mechanism, an electric circuit passing through the motor and automatic mechanism for breaking the circuit when the brake becomes set.

518,782. DISTRIBUTION SYSTEM FOR ELECTRIC RAILWAYS; J. E. Goodhand, Baltimore, Md. Application filed Jan. 20, 1894. The combination of the feeder and working conduits; branch conduits arranged transversely to and connecting the feeder and working conduits; feeder wires in the feeder conduit, electrical conductors arranged in sections in the working conduits; a connecting block at the intersection of the branch and feeder conduits, and branch wires connecting the feeder wire with the working conductor.

518,788. ELECTRICAL INSTRUMENT TABLE; J. F. Mehren, Chicago, Ill. Application filed Feb. 7, 1893. A table having in its top conducting terminals, in combination with a set of electrical instruments and withdrawable fasteners connecting the instrument wires with the terminals and engaging the instruments to fasten them to the table against separation therefrom.

518,793. LIGHTNING ROD AND COUPLING; J. W. Smith, Galesburg, Ill. Application filed Jan. 6, 1893. A rod comprising sections of metal having an enveloping tube of copper, the sections of rods having tapered ends, which extend well on to the copper envelope, and a sleeve of copper having socketed ends and a conformity of outline with the conical ends of the rod sections, and extending on to and over the tapered part of the enveloping tube, whereby there may be an extended surface contact of the copper of the sleeve and the rod section.

518,800. ELECTRIC SWITCH; E. Woltmann, Chicago, Ill. Application filed July 11, 1893. This comprises a rotary wheel having cams and a crown ratchet, a contact terminal, a second resilient contact terminal riding upon the cams and actuated thereby in successive partial rotations of the wheel alternately to engage and separate from the first terminal, a pawl engaging the ratchet, and means for actuating the pawl to rotate the wheel a partial revolution with each operation.

NO. 518,793.—LIGHTNING ROD AND COUPLING.

518,813. ELECTRIC SWITCH; W. S. Hill, Hyde Park, Mass. Application filed Oct. 31, 1893. The combination with the contact pieces, of blades adapted to connect therewith to close the electric circuit, the contact pieces having flexible plates between which the blades pass to close the circuit, and rigid reinforcing plates secured thereto to increase the carrying capacity of said contact pieces.

518,877. ELECTRIC RELEASING DEVICE FOR DOORS; S. H. Curwen, Salem, Mass. Application filed July 12, 1893. The combination of a series of automatically closing doors or windows, a main line, branch circuits each including an electromagnet, a circuit closer interposed between the main line and the branch circuits, a contact arm, a mechanical motor for rotating the same, and a pivoted lever normally holding the motor against rotation, but permitting, when released, one complete revolution of the contact arm.

518,885. TABULATING SYSTEM; H. Hollerith, Washington, D. C. Application filed Aug. 1, 1893. The combination of a switch mechanism controlled by a record card, a series of independent circuits, each containing a relay and connected with the switch mechanism and a normally open independent local circuit, including the circuit controlling devices of the relays arranged in series.

518,886. TABULATING SYSTEM; H. Hollerith, Washington, D. C. Application filed Nov. 17, 1893. The combination with the integrator, switch mechanism, registers, and a starting circuit controlled from the switch mechanism, of a series of circuit controllers located in a branch of the starting circuit and controlled through relays connected to the switch mechanism.

518,894. ELECTRIC BELT; P. E. Petterson, Minneapolis, Minn. Application filed July 26, 1892. This comprises a series of batteries connected by wire links, each battery being composed of a bent zinc plate, absorbing felt folded about the plate, the plate secured on one side of a connecting link and a long and single sheet of zinc copper having its end curled about the side of the next link and thence extending entirely around the felt and lapping around itself.

518,906. AUTOMATIC DEVICE FOR REMOVING RESISTANCE IN STARTING ELECTRIC MOTORS AND REPLACING SAME; G. H. Whittingham, Baltimore, Md. Application filed April 4, 1893. This comprises a motor, a resistance coil, a movable contact device in circuit therewith; a pawl and ratchet operated by the motor armature and adapted to impart to the contact device a limited movement in the direction which reduces the resistance of the armature circuit, and means for disengaging the pawl and ratchet when the supply of electricity is cut off.

518,907. CLEAT FOR SUPPORTING CONDUCTING WIRES FOR ELECTRIC CIRCUITS; H. B. Wyman, Slingerland, N. Y. Application filed Dec. 20, 1893. An insulating cleat having a central fastening screw and its ends curled to form a hook to receive the wire, the points of the hooks so formed being impinged against the support for the cleat.

518,913. COMMUTATOR BRUSH; G. W. Brown, Deering, Me. Application filed Nov. 15, 1893. A commutator brush composed of woven wire cloth folded together and the inner layers only of which are impregnated with a graphite compound left in a soft yielding condition and adapted to make contact at its end with a commutator.

518,916. TELEPHONE TRANSMITTER; H. Cottrell, Newark, N. J. Application filed March 15, 1894. This comprises a variable resistance piece, consisting of a conducting base having projections extending therefrom, a diaphragm susceptible of being vibrated by sound waves and means for varying the contact between the projections, in correspondence with the vibrations of the diaphragm, to produce variations in the current.